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Rearing of Chickens.

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INTRODUCTION.

THE heavy mortality occurring in the rearing period of the domestic fowl is becoming more evident year by year. This percentage of deaths is so high that, did it occur in other stock, an immediate drive, by all interested, would be made to stop this excessive wastage. The successful rearing of strong, healthy birds is the salient factor governing profit or loss on the poultry farm.

Present day needs make it necessary to produce chickens in large numbers, but modern intensive methods and mass production require a high standard of knowledge and skill in the operator. Even with the specialised knowledge the rate of mortality will still be high if the parent stock are not possessed of a strong vigorous constitution capable of resisting disease. To get real progress in chicken rearing the poultry industry will have to support pedigree breeding establishments; where, by genetic breeding, resistance to disease can be established, and where all breeding stock would be tested for such diseases as Pullorum until no positive reactors can be found.

Few pedigree breeding farms have been a financial success because this type of breeding is expensive, but poultry farmers will be forced to support these to decrease the mortality in their flocks, and in the rearing of their chickens.

A State Breeding and Experimental Station coupled with a Poultry Improvement Plan as in operation in the United States of America would go far in the solution of the high mortality problem. The objectives of this Plan are well worth consideration and are outlined as follows—

(1) To improve the production and breeding qualities of poultry.

(2) To reduce the mortality of chicks from Pullorum disease.

(3) To identify authoritatively, breeding stock, hatching eggs and chicks with respect to quality, by describing them in terms uniformly accepted.

(4) To serve as a means through which scientific research may be applied for the improvement of poultry and poultry products.

A plan such as this would be of immense value in improving the average quality of poultry throughout the country, would check the increasing mortality in chickens and place the industry on a firmer financial base.

GENERAL.

The foundations of a successful poultry farm are the breeding stock, and the treatment the chickens receive during their development to maturity. These two salient factors are linked together because a flock of well grown, disease resistant birds must be raised annually as future breeders and be capable of withstanding the strain of continuous egg production.

When chickens are produced on the farm it is essential to breed only from Pullorum tested stock of a high egg producing and disease resistant strain. Special attention should be given to the selection of the males which should be progeny tested. The above qualifications may not be easy to obtain but they are necessary fundamentals to successful poultry farming.

Today, it is common practice to purchase day-old chickens from a hatchery or from a well established poultry farmer. It is estimated that 75 per cent. of the chickens raised in Western Australia are purchased from these sources. It is to be expected that chicks can be produced more cheaply on a large scale than on a small scale.

If it is necessary for the poultry farmer who breeds from his own flock to consider the factors previously mentioned, it is equally necessary for the purchaser of day-old chickens to obtain all the information possible before he places his order with a hatchery. However good the chicken rearing management may be, it is obvious that satisfactory pullets cannot be reared from chicks of poor breeding stock. Chickens should be purchased only from breeders or hatcheries with a reputation for sending out healthy, disease resistant stock. Chickens of inferior quality which may be offered at a low price are not worth purchasing and are a menace to other birds.

Those breeders and hatcheries who have built up a reputation for good stock are usually inundated with orders and to procure chickens at the right time they should be ordered many months previously. In some cases orders, especially repeat orders, are booked 12 months ahead.

Time of Hatching or Purchasing.

The hatching season is a limited one; neither very early hatched nor late hatched stock are desirable. Chicks hatched at the correct time usually grow better and suffer less mortality than those hatched at other dates, and should be in egg production in the autumn and winter which is the period of high egg prices. For their early hatched chicks hatcheries have to rely to a great extent on pullet eggs which do not produce the large, healthy, vigorous chick which is essential if the percentage of mortality is to be kept low during their lifetime.

Late hatched chicks are usually slow in maturing and do not come into production until probably as late as June or July when the fall of egg prices occurs.

In the vicinity of Perth the most successful rearing is obtained by hatching from mid July to the end of August for heavy breeds and from 1st August to the middle of September for light breeds. This statement should be used only as a guide and local conditions should decide the hatching or purchasing date.

The area declared by the Controller of Egg Supplies can be considered as the egg producing districts of Western Australia. It commences some miles north of Geraldton, includes Merredin on the Eastern Goldfields Railway, and then follows No. 1 Rabbit Proof Fence to the coast east of Hopetoun. It is obvious that climatic conditions must vary considerably over this large area. In the extreme northern and eastern portions, where summer conditions are experienced early, it is advisable to commence the chicken rearing season a month earlier than the time previously stated. Conversely, in the extreme south-west portion of the State, approximately south of a line drawn from Bunbury to Albany, the best results are obtained when chickens are hatched a month later than the Perth dates.

It cannot be too strongly emphasised that the date of hatching is an important factor in future egg production. Pullets hatched too early may come into production in December or January and after a few weeks laying may go into a moult, at the same time as the hens, and not come into production again until the end of June or July.

The Importance of Sanitation and Fresh Air.

As the maintenance of a high degree of sanitation and the provision of a constant supply of fresh air are two important factors during the growing period of the chick, it is necessary to comment in a general manner although details will be noticed throughout this article. Unsanitary environmental conditions have an adverse effect on young stock by giving optimum conditions for the increase of disease bacteria, and by rendering the chicks more susceptible by lowering their resistance to disease. The term "sanitation" is used in its widest form and embraces not only cleanliness, but overcrowding, ventilation, uncontaminated soil, and freedom from internal and external parasites.

The periodical removal of the excreta is not sufficient to maintain the standard of cleanliness required but everything with which the chicks or developing stock come into contact must be kept in a sanitary condition. Cleaning is best done by removing any excreta or dirty litter and then scrubbing with caustic soda solution followed by a liberal spraying with a 5 per cent. coal-tar disinfectant.

Food and water should be provided in the most sanitary conditions possible. Contamination of food and water can be largely avoided; hoppers and drinking vessels can be so constructed that the chickens and growing stock can be prevented from getting into the food and water. In badly constructed hoppers the food falls on the floor, becomes filthy and causes digestive disorders and disease. Covered drinking vessels can be used to keep out droppings and dirt.

Overcrowding is the source of many troubles throughout the life of the domestic fowl. Research work carried out by the Delaware Extension Service shows that overcrowding increases the percentage of deaths, retards the rate of development, decreases the average weight per bird, and increases the amount of food consumed per unit of weight gained. Crowding accentuates the problems of moisture control and ventilation; wet floors or moist patches on the floors are common, and ammonia vapour lowers the resistance to disease and assists the spread of colds and coccidiosis.

When chickens are reared in a floor type of brooder it is generally considered that ½ sq. ft. per chick is sufficient floor space for the first six weeks. For example a section of a brooder house measuring 5 ft. x 12 ft. will accommodate 100 chicks until they are six weeks old. A plentiful supply of fresh air is required by the chick even in its embryonic stage in the egg and after it leaves the shell this need for fresh air increases as the chicken develops.

Lack of proper ventilation in the brooder house results in stuffy, unhealthy brooders and damp litter and chicks reared under these conditions are more susceptible to colds, feather badly, and consequently feel cold quickly and suffer high mortality. The brooder house should not be draughty, but should be efficiently ventilated to dilute and remove carbon dioxide and moisture given off by the lungs, and remove carbon monoxide resulting from burning by lamps or brooder stoves. The brooder house must have fresh air during cold weather and at night, and the brooder should be warm enough to allow the passage of fresh air at any time. Provided there is ample heat under the brooder, chickens will grow better in a cool brooder house than in a warm one. Chicks are also warmed by internal heat generated by the combustion of the food they eat, and for this process they need oxygen which they can obtain from the air. Chicks in a stuffy brooder will always huddle because the natural process of heat production is being retarded by an insufficient supply of oxygen. The need for efficient ventilation is noticeable throughout the life of the bird; a poorly ventilated laying shed exhibits ideal conditions for the spread of colds in maturing pullets, with a consequent lowering of egg production in the early part of the laying season.

One of the causes of slow growth of young stock is the continued use of contaminated ground. This aspect of sanitation has been neglected in the past but poultry farmers are becoming aware that clean ground is essential during the early stages of rearing. As it is not practicable to attempt disinfection of ground, it is essential to prevent contamination as far as possible. Fresh ground each year is preferable, but is not always possible. However, the rearing area can and should be reserved for that purpose only, and during the time it is not in use can be sweetened by cultivation and by growing a green crop. Once land becomes contaminated with intestinal parasites, pullorum disease, or coccidiosis it is practically impossible to rear healthy chickens, and that area should not be used for the purpose for two years. The area selected as the rearing ground should be well drained so that no small pools of stagnant water collect on the surface, and it should be well away from the laying flock as old birds are a common source of infection.

Brooder House and Brooders.

It is beyond the scope of this article to describe in detail the various buildings suitable for brooding chickens, but the kind of house used should be one that is adapted to the type of brooder employed. The principles essential in all brooder houses are the same and include good ventilation without draughts, sufficient light with the admission of direct sunlight, possess a dry floor capable of being easily kept in a sanitary condition and free from vermin, adequate floor space, give protection and warmth, and be a well constructed durable building.

Owing to the shortage and high cost of building materials it has been a common practice in Western Australia, in recent years, to brood chickens in a laying shed instead of in a special brooder house. Under the circumstances it can be considered that this practice has been reasonably successful, but it should be regarded as only a makeshift and a brooder house should be constructed when conditions permit. If a shed which has previously housed poultry is to be adapted for use as a brooder house special sanitary precautions should be taken some weeks before the chickens arrive. Spray the woodwork with the creosote mixture suggested for the eradication of tick and red mite and spray the entire shed with a good disinfectant. Thoroughly clean up the area

surrounding the shed and cultivate the ground in the yards and plant a green crop. A laying shed can be divided by temporary divisions to accommodate three or four brooders.

There are many different systems of brooding in use and a varied assortment of brooders from which to make a choice, the majority of which will give satisfactory results if properly operated. Where electricity is available for brooder heating it is almost ideal because of the ease of operation and the simplicity of control, but it has one definite disadvantage, that is, the complete loss of heat during a breakdown of the power. Many types of electric brooders are now manufactured with an auxiliary kerosene lamp heater which can be used when necessary.

The back-yard poultry keeper with his dozen hens usually gets better egg production per hen than the commercial poultry farmer with his flock of 2,000 birds; in the same manner, small to moderately sized groups of chicks give better results than large groups, but the group cannot be too small because the cost of housing, equipment and labour would be uneconomical. It would appear that groups of 100 chickens are most satisfactory, but nevertheless, good results are obtained from groups of approximately 250 under colony brooders. The rapid expansion of the industry, and the larger farms now operating, have encouraged the use of large battery brooders, but they are divided in such a manner that the 100 group is retained.

When purchasing equipment, it should be remembered, that the chick capacity of a brooder is usually rated high by the manufacturer and allowances should be made accordingly. The capacity of a brooder is the number of birds it will brood towards the end of the period it is intended to keep the chicks under that particular brooder. For example, a brooder reputed to carry 200 chicks may give ample room when the chicks are day-old, but the chickens grow very fast, and at a fortnight old they would become overcrowded and each day would increase the congestion.

The number of chickens it is intended to rear during the season will, to a great extent, determine the type of brooder to be used.

Small Single Units.

If poultry rearing is a sideline and not more than 200 chicks are required, it would be advisable to use the single 100 chick brooder, which can be either an electric or kerosene lamp heated type, or a combination of both. Fig. 1 shows one of the many makes of the lamp heated brooder which are commonly used.

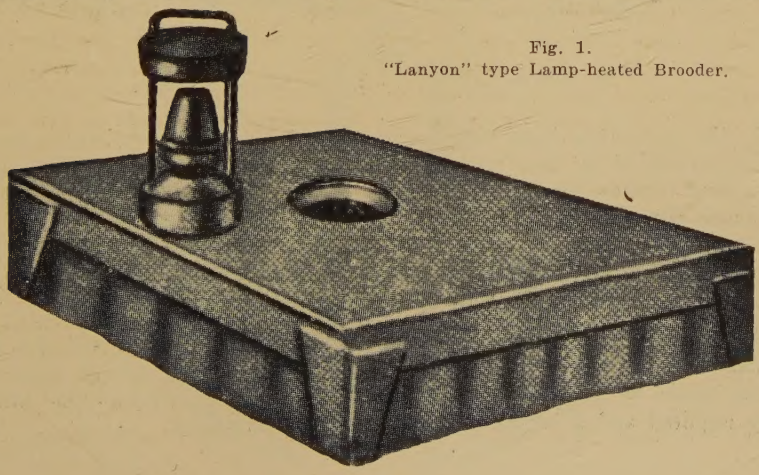


Fig. 1.
"Lanyon" type Lamp-heated Brooder.

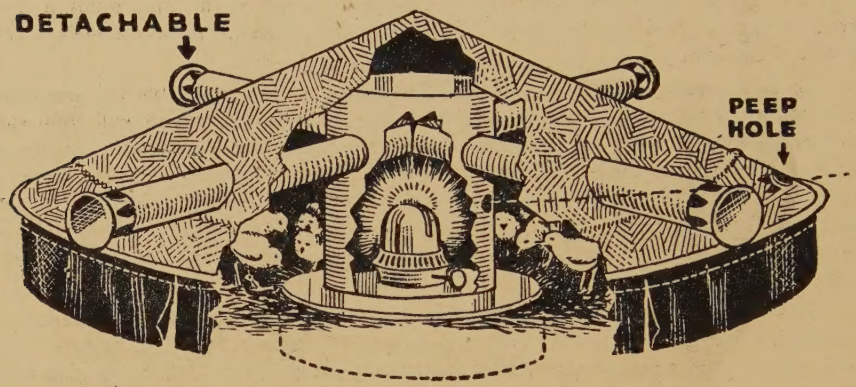


Fig. 2.
"Westworth" Lamp-heated Brooder. Manufactured in Western Australia.

Fig. 2 illustrates another type of kerosene brooder which gives good results when operated correctly. This brooder is manufactured under patent in Western Australia and is becoming popular. Fig. 3 is an electric brooder, but should the power fail the auxiliary kerosene burning heater can be used. This is primarily an electric brooder and on medium heat consumes 1 unit of current in approximately 6½ hours.

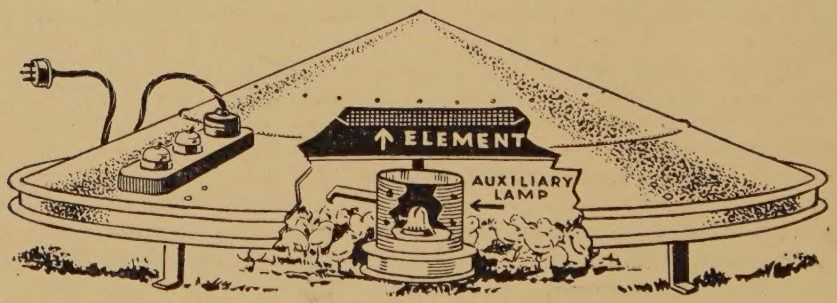
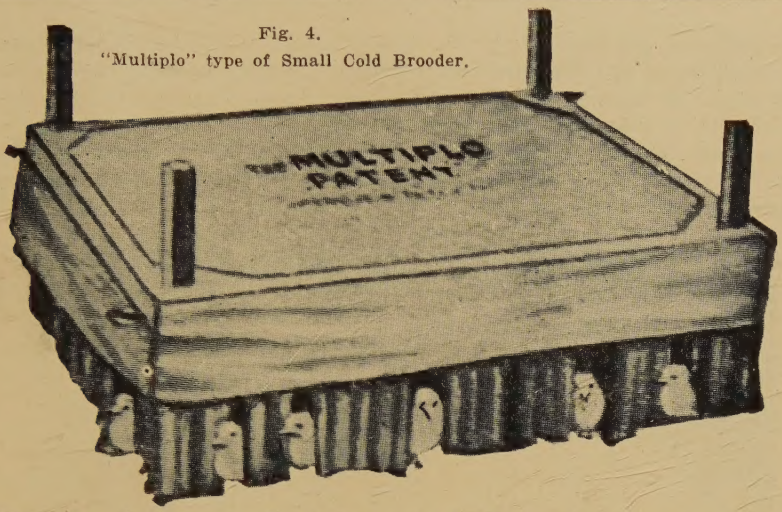


Fig. 3.
Electric Brooder with Auxiliary Kerosene Heater.

In the past there have been many methods of heating by electricity; some brooders depended on heat from one or more filament lamps, others were fitted with a long tubular lamp but these methods have been superseded by the use of "resistance wire" units. The heating unit is fixed near the apex of a conical metal brooder or in the top of the flat type of hover. Seventy feet of No. 8 or 120 feet of No. 16 ni-chrome (nickel-chromed) wire will give a temperature of 92°F. under a normally constructed 100 chick brooder.

As previously stated the three types of brooders illustrated are each a single unit capable of brooding 100 chicks, but if a larger chick capacity is desired two or more could be installed, but if several are used it increases the amount of labour required and a larger type of brooder is indicated.

Fig. 4.
"Multiplo" type of Small Cold Brooder.



When brooder capacity is limited and the heated brooder is required for another batch of chickens it is common practice to transfer the chicks to a cold brooder when they are about 3 weeks old. Details of the change will be dealt with later under the heading of management but Fig. 4 shows a type of small cold brooder which can be used in conjunction with the 100 chick heated brooders described previously.

Colony Brooders.

Where it is necessary to rear a large number of chickens during the season a different type of brooder must be used. Two systems have given good results in the past, but where electricity is available they have been superseded, to some extent, by the battery brooders. However, the first of these, the colony brooder, has proved satisfactory in operation. It consists of a circular metal canopy with the lower edge, supported on iron legs, approximately 4 inches above the floor. The diameter at the bottom edge is 4 to 5 ft. and the heating unit is in the centre. Necessary ventilation is provided at the top of the hover, except in the case of the sawdust brooder.

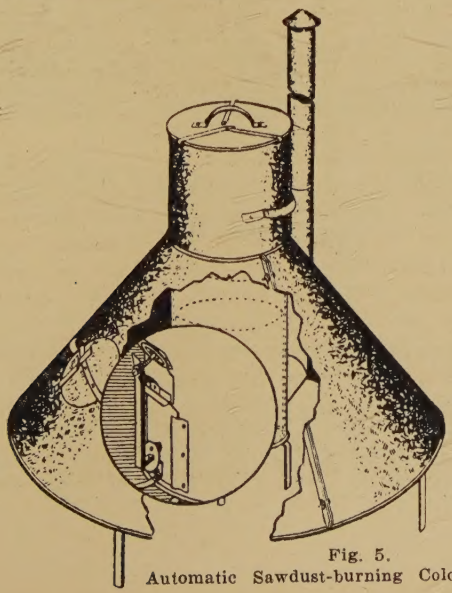


Fig. 5.
Automatic Sawdust-burning Colony Brooder.

Fig. 5 is an automatic sawdust burning colony brooder which has capsule controlled heat. One filling of saw dust burns 12 to 18 hours and the most satisfactory results are obtained with batches of about 350 chickens. At the Parafield Poultry Station, South Australia, most satisfactory results have been obtained for some years with a colony brooder using a "Puritan" burner. Fig. 6 shows the colony brooder in use at Parafield and is as illustrated in Bulletin 365 of the Department of Agriculture of South Australia.

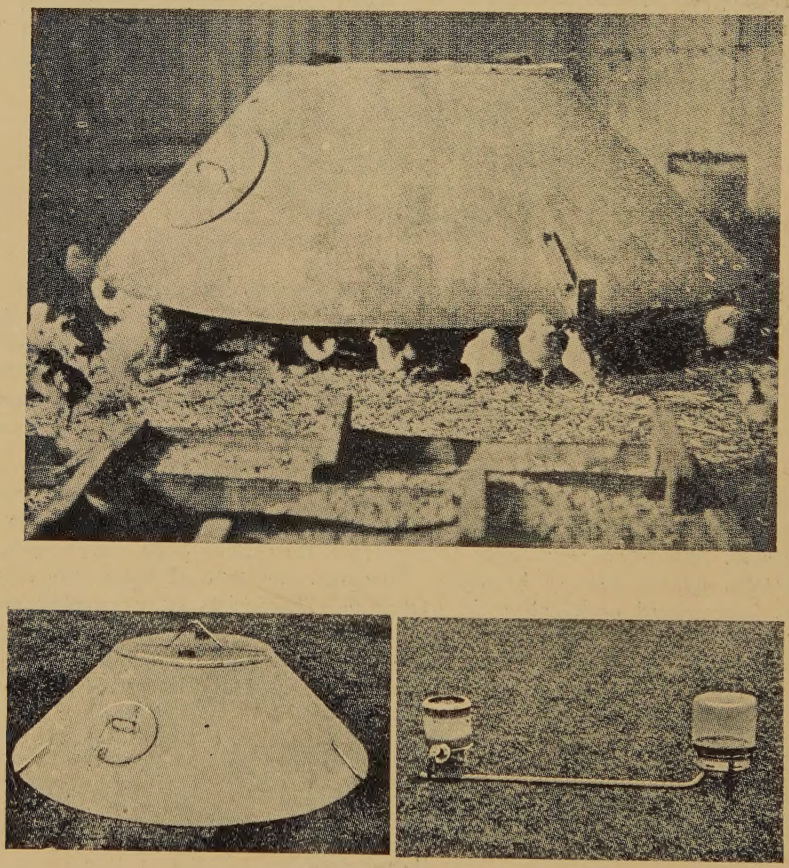


Fig. 6.
Kerosene-burning type of Colony Brooder.

Hot Water Brooding.

Hot water systems of brooding have been common for some years on large commercial farms. A hot water boiler is placed in one end of a long brooder house, and a pipe system runs the length of the house. The floor of the house is divided into sections each capable of carrying 100 chickens. In each section the pipes are covered by a canopy or brooder to preserve and throw down heat on the chickens. To maintain the required temperature in the long pipe system it is necessary to give constant attention to the boiler, including stoking during the night, which makes this system of chick brooding rather laborious. Should this system be installed care must be taken to ensure that the boiler is large enough to supply a reserve of heat to cope with low atmospheric temperatures.

Battery Brooders.

Not many years ago the first battery brooder made its appearance, and in spite of considerable criticism has become popular. This is no doubt due to the fact that its use has reduced to a minimum the labour, care and attention required by the chick for the first three weeks of its life. Experimental and practical work with this type of brooder has demonstrated that best results are obtained when the chicks are held for three weeks in the battery brooder and then transferred to cold brooders. The usual type of battery brooder consists of four tiers, each tier capable of holding 100 chicks, and each having separate heating. In some brooders the temperature of each tier is controlled separately, while in other designs a master control operates all sections and the temperature in the individual compartments is varied by control of the ventilators. The heating unit is usually an electric one but in districts where electricity is not available the battery brooder works quite satisfactorily with a kerosene lamp as the source of heat. Some makes of electric battery brooders are equipped with auxiliary kerosene heating as a safeguard in the event of a breakdown in the current.

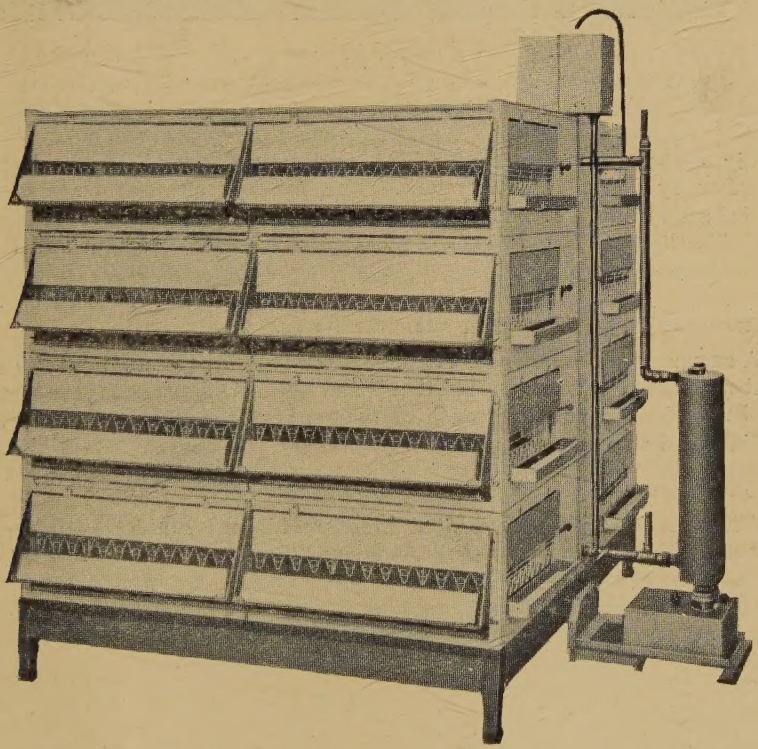


Fig. 7.
"Gloucester" type of Oil-burning Battery Brooder.

Fig. 7 is an illustration of a "Gloucester" battery brooder of the oil burning type and is capable of holding 1,000 chicks. Ample room for feeding is given by the troughs attached to the sides and water is correspondingly catered for.

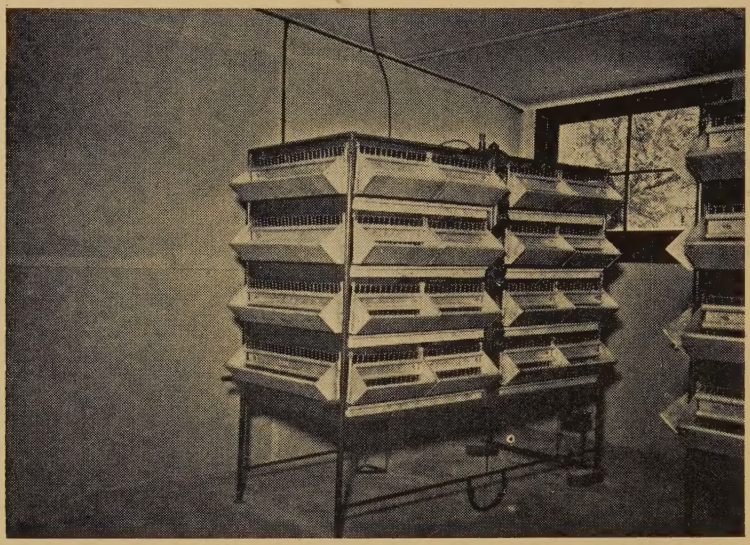


Fig. 8.
Electric Battery Brooder, with Auxiliary Kerosene Heater, 400 chick capacity.
On Mr. M. Stocker's Poultry Farm, Roleystone.

Fig. 8 shows a corner of the brooder room on Mr. M. Stocker's "Cavvystock Poultry Farm" at Roleystone. The brooders are 400 chicken capacity electric battery brooders which are fitted with the kerosene lamp auxiliary equipment. The brooder is 6 ft. long, 2 ft. 6 in. wide, and 5 ft. high and the floors are constructed of ½ in. square mesh netting which enable the chickens to be kept under very sanitary conditions, as the droppings are collected on and can be cleared from trays beneath the wire floors.

A summary of the salient points of battery type brooders shows their economy of labour, sanitary rearing conditions, and the small percentage of mortality, good body size and feather growth of the chickens for the three weeks they are kept in the battery.

Cold Brooders.

After three weeks in a heated brooder chickens can be transferred to a cold brooder. Fig. 4, as previously mentioned, illustrates a type of cold brooder which is quite successful for small numbers of chickens but which entail too much labour if large numbers of chickens were to be reared. Fig. 9 shows the exterior of the long cold brooder house on Mr. Stocker's farm, and Fig. 10 is a portion of the interior of the same building showing the general arrangement of the cold brooders. The cold brooders on this farm have proved most successful and are similar to those in use at the Parafield Poultry Experiment Station, South Australia, which are most efficient to rear chickens from the time they are three weeks old until six weeks of age. The following description, and Fig. 11 (showing the design of the cold brooder) is given in Bulletin No. 365 by Mr. A. A. McArdle, Manager, Parafield Experiment Station, South Australia: "The cold brooders are capable of holding 80 chickens comfortably from three to six weeks of age. The length of the brooder is 5 ft. 6 in. and it is 2 ft. 6 in. wide—both internal measurements—and the height in front is 2 ft. 6 in. and at the back 2 ft. Wire-netting frames are used above the floors with very good results.

The brooder is kept in a sanitary condition and the dangers of crowding are avoided, as the chickens underneath, if crowding occurs, are able to obtain air. The brooder is divided into two sections; one for sleeping quarters, the other for feeding. The quarters are separated by a division 2 ft. 6 in. wide by 2 ft. high (front and back), constructed so that it can be lifted out if required.

The sleeping quarters are 2 ft. 6 in. by 2 ft. 6 in. and the run is 2 ft. 11 in. by 2 ft. 6in. The uprights are outside the actual brooder box to allow the wire-netting frames to fit properly. These are constructed of 2 in. by 2 in. oregon and are one inch smaller than the size of the quarters as it is necessary to remove the frames for cleaning purposes. The mesh used is standard ½ in., and it is advisable to cover the edge of the netting with a strip of galvanised iron. The sleeping compartment has a light frame 2 ft. 5in. by 2 ft. 3in. constructed of 1½ in. by 1 in. oregon and covered with ordinary hessian, which is held in position by stops so that it is 12in. above the wooden floor. These frames assist in keeping the chickens warm when first moved to the brooders but can be removed after seven or eight days. It is very necessary to see that for the first few nights the chicks are closed in the sleeping quarters. The entrance to the sleeping quarters is through a 6 in. by 4 in. opening which is equipped with a slide, and a similar opening in the front of the feeding compartment permits entry to the outside run. The roof is constructed in one piece and is hinged at the front of the brooder, allowing the whole roof to swing up to permit feeding and changing operations. The floor is constructed of flooring board supported on three 3 in. by 2 in. jarrah pieces 2 ft. 6 in. in length, the intervening gaps at the front being closed with 2 in. by 1 in. jarrah to prevent chickens getting under the brooder. Fig. 11 contains further details of construction.

In choosing a brooder system the main consideration must be the provision of conditions conducive to the rearing of sound healthy stock but the number of chicks to be reared, the saving of labour, and the capital outlay must be the deciding factors.

Brooder Operating and Chick Management.

Whatever system is used success depends very largely on sound management. Battery brooding will be referred to later, but with all other types of brooders there are certain fundamental practices and preparations that are essential. Under Western Australian conditions the best floor for a brooder house is a well-finished concrete floor with a smooth surface as it is easy to keep in a sanitary condition. If a new concrete floor is laid it should be completed at least four to six months before it is needed for the brooders as it takes months for green concrete to dry out. If the brooder house has been used in previous seasons it should be thoroughly cleaned, especially the floors, two or three weeks before the brooders are needed.

The floor of the brooder pen should be covered with litter to a depth of one to two inches. Several different types of litter have proved satisfactory and among these are dry clean sand, clean chaff, and white sawdust, but the essential point is to renew the litter as soon as it becomes foul or damp. This especially applies to the litter under the brooder which in spite of the heat may quickly become damp and badly soiled, and after the first few days should be changed daily. It has become common practice to place a cut-open bag under the brooder on which is sprinkled a small amount of litter, the bag with the "accumulated droppings" is removed each day and replaced with a clean bag and litter. The bagging can be cleaned and dried in the sun and used throughout the brooding season. Some poultry keepers find the use of a wire-netting

frame placed on the floor under the brooder is an aid to cleanliness. The frame is made of 2 in. x 2 in. timber covered with ½ in. mesh wire-netting and is large enough to project about a foot beyond the edge of the brooder. A piece of sacking is placed on the wire-netting and replaced daily, as mentioned above, but when the chicks are about one week old the sacking should be removed and the chicks will walk on the wire netting. The wire frame allows air to circulate under the chickens and prevents any dampness under the brooder, and once the sacking is removed the droppings pass through the netting and the chickens are sleeping under more hygienic conditions.

Fig. 9.
Exterior of Cold Brooder House on Mr. Stocker's Farm.

Fig. 10.
Portion of the interior of the Cold Brooder House.

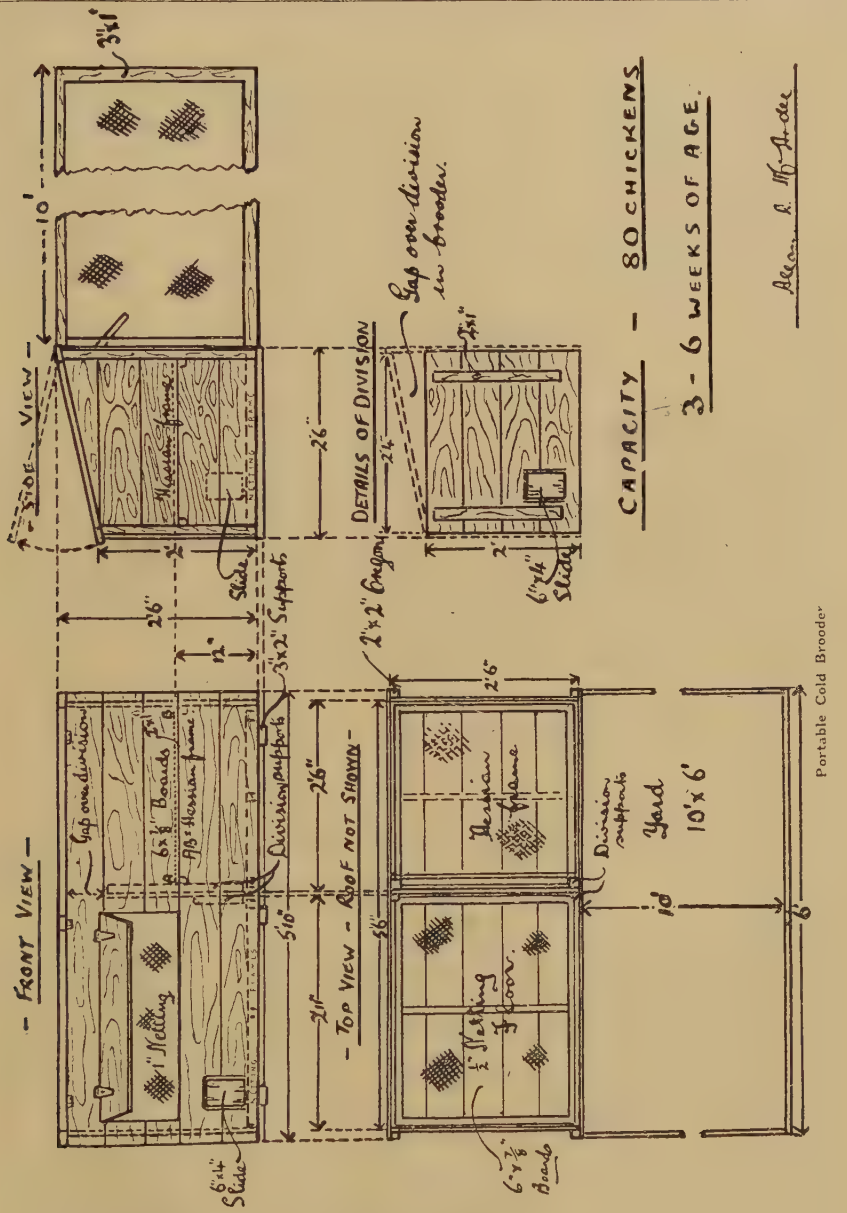


Fig. 11.
Designs of the Cold Brooder used at Parafield Poultry Experiment Station.

Preparing the Brooder.

The brooder should be warmed up two to three days before it is actually needed so that the brooder and its surroundings will be thoroughly dry and warm before the chicks are placed in the brooder. If the brooder is controlled by a thermostat the necessary adjustments should be made before commencing actual brooding but if the brooder is not thermostatically controlled the temperature under the brooder should be checked by a thermometer. As a general guide, the

temperature under the brooder at chick-level, for the first week, should be about 90°F. During the second week the temperature should be 85°F. and lowered to 80°F. for the third week. Once the chickens have been placed under the brooder their conduct will indicate the temperature they require. An increase in temperature is indicated when the chicks crowd towards the centre of the brooder in an endeavour to obtain sufficient warmth, while a decrease is necessary when there are signs of panting and the chicks crowd away from the source of heat. The best results are obtained when there is sufficient heat to allow the chicks to spread themselves out comfortably under the brooder near its outer edge. When chicks are quite comfortable as regards warmth and feed they are comparatively silent but when a shrill chirping is heard it is a sign that something is wrong and it is usually that the brooder is not warm enough.

When chicks are placed under a brooder they must be confined to the brooder itself and its immediate surroundings. Day old chicks are liable to wander away from the source of heat, and apparently cannot find their way back and become chilled which may develop into pneumonia. To prevent this a circle of metal about 18 inches high is placed around the brooder. This guard should be placed about a foot away from the edge of the brooder and enlarged each day or two as the chicks become "brooder wise". The guard not only prevents chicks straying from the brooder but it prevents ground draughts rushing under the brooder, but it must allow chicks room to get away from excessive heat as chills are often caused by chicks being kept in overheated brooders.

Placing Chicks Under the Brooder.

The first step in successful brooding is to have the brooder ready for the chicks when they arrive by transport or from the incubator. When transferring the chicks from the incubator, or the boxes, great care must be taken to ensure that they do not catch a chill, but it is advisable to handle each chick, count them, and dispose of all weaklings as they are a possible source of disease. If the brooder is running at the proper temperature chicks may be placed in it at any time during the day. If chicks are transferred to brooders in the morning it will be noticed that a few of the vigorous ones will wander outside the brooder as far as the guard will allow, but a frequent watch will ensure that these chicks go back to the warmth. On the other hand, chicks put under in the late afternoon will often settle down quickly and will not come out until the next morning. The daily routine with the brooders should be cleaning under the brooders, checking on the temperature, keeping the litter in a sanitary condition, and allowing the chicks more space every day or two.

When to Allow Chicks Out Into the Yard.

No definite statement can be given as regards the age that chicks should be allowed out in a yard but, as a guide, after they are 5 days old and provided the weather is satisfactory, the quicker they are out in the sunlight the healthier they will become. Practical experience indicates that chicks which get out early on to the ground are hardy, healthy chicks, they feather correctly and grow quickly. For the first day or so they should be allowed out only for about two hours, and it should be at a time when there is no shadow in the yard for the chickens to stand in. It will be necessary to put the chickens back into the brooder house once or twice but after that they will soon learn to find their way back. After the first day or two the chicks will be anxious to get into the yard and provided the sun is shining and it is not extremely cold or wet they can be allowed

out all day. Care must be taken that the runway leading from the yard to the chicks' entry door of the brooder house is constructed in such a manner that the chicks cannot get beneath it, but rather, that a chick approaching from any direction has easy access to the entrance.

Weaning from artificial heat.

As the chicks grow more body heat is generated and at the end of about three weeks of artificial heat the chicks are either removed to a cold brooder for another three to four weeks or the temperature of their brooder is gradually reduced. Great care should be taken when the chickens are first moved into the cold brooders. If the weather is unfavourable they should not be allowed into the yards or if the brooder is of a portable type the chicks should be kept closed up for a day or two to avoid chills. If the weather is fine they are allowed a short period in the run on the first day, gradually increasing the time as they become accustomed to the cold brooder. It is evident that a chick which has been used to running in from the yard to a heated brooder will require careful treatment until it gets used to its new conditions. When chicks remain in the heated brooder they are generally ready for a gradual hardening off at three to four weeks. Turning off the heat for a short period in the middle of the day and gradually lengthening the period is the method usually adopted. At about this time it will be noticed that some of the chicks are either sleeping just outside the brooder or are perched on top of it, and this is an indication that weaning can be successfully carried out.

The gradual lowering of the temperature and the periods of no heat must be at the discretion of the operator as it is governed by climatic conditions.

At six to seven weeks old the chickens should be moved to the rearing sheds which may be either a semi-intensive shed or colony houses.

Management of Battery Brooders.

The modern battery brooder is practically fool-proof and provided the necessary procedure is carried out will rear a high percentage of healthy chicks. The best results are obtained when chicks are battery brooded for approximately three weeks and then moved to cold brooders for a further three to four weeks. If chicks are kept for more than three weeks in the battery they become crowded and there appears to be greater likelihood of mortality when they are placed in ground brooders. The temperature control of the brooder is based on 90°F. for the first few days, gradually reducing by easy stages to 80°F. during the third week. The brooder should be running for at least a day before it is required for the chicks, which are then placed in the warm section of the brooder. Newspaper is placed over the wire floor and renewed daily for three or four days, after which the chicks walk on the wire floor. A small area is allowed at the side of the warm portion where the chickens can feed and drink in partial warmth, and the area is enlarged from day to day. The battery rears a large number of chicks in a small space so it is important to keep it in a sanitary condition; the droppings must be cleared from the trays beneath the wire floors daily, and the brooder room must not be too hot but sufficiently ventilated to provide the fresh air required by such a large number of chicks. All movable parts of the battery should be thoroughly cleaned and disinfected between each brood of chickens, and the wire floors should be cleaned with a wire brush. A large container for soaking equipment is a necessary accessory for all battery plants. An important point is that rays of sunlight should not shine on to the wire floors, it will encourage the chicks

to commence picking at each other which may develop into feather pulling or toe picking. As the chickens cannot get into their food and water containers these brooders ensure that the food and water consumed is absolutely clean.

Management of Chicks After the Brooding Stage.

It has been common practice in Western Australia in recent years to crowd up the old stock and rear chickens in a vacant laying shed, probably because it saves the expense of special rearing sheds which would remain idle for eight months in the year. This practice is not good poultry husbandry as it means the young birds not two months old, are moved into sheds and yards which are stale, if not contaminated. Under these conditions it cannot be expected that the young birds will make satisfactory growth or develop into hardy, thrifty stock. There is too much risk of them becoming infested with worms or contracting disease through close contact with older birds. It has been noticed that young stock reared on stale ground do not develop evenly, there are too many culls and their unhealthy growing conditions must have an adverse effect on the future egg production of the pullets.

Most poultry farmers now realise that the best rearing results are obtained by the use of some types of colony system. Many types of colony houses are used with success, some are portable and others are permanently placed on the rearing ground.

The general farmer or orchardist, rearing two or three hundred pullets each year as a side line, could, with advantage, use a portable type of colony house. Fig. 12 is a copy of an illustration of a rearing coop for growing stock on range, published in a Poultry Bulletin by the Department of Agriculture, Tasmania. The structure is cheap to make, and is light in weight, rendering it easy to move to a new position, which should be done once each week. The floor is of small mesh wire-netting. Ample wide perches should be provided and raised not more than a foot from the floor.

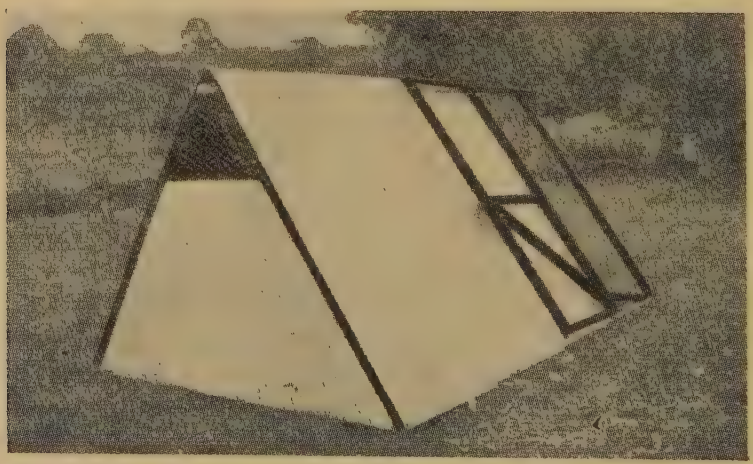


Fig. 12.
Rearing coops for growing stock on range.

Paddocks or orchards with an abundance of green feed and shade are ideal and will give excellent results. Incidentally the fertility of the soil will be improved, and better rearing results obtained, by using fresh rearing ground each year.

It is usual to surround the colony house with a temporary fence for the first week until the young stock get used to their new quarters, after which it can be removed and the stock allowed to range, but they will return to roost in their own house at night, even if they mingle with other birds from other sheds during the day.

For the commercial poultry farmer a restricted type of colony rearing is necessary. The aim should be to have rearing grounds where not more than 900 birds to the acre should be housed. An acre of land is divided into three large wire-netted enclosures and in each enclosure three rearing sheds are placed in such positions that they are as far apart as possible. Each shed is capable of holding 100 young pullets until they are ready to be moved to the laying sheds. It is desirable to have them quietly settled in the laying sheds two or three weeks before they come into lay, therefore, the time to move them is when the comb commences to develop and "redden up."

Fig. 13 shows the type of rearing shed which has proved successful at Parafield Poultry Experiment Station, South Australia and Fig. 14 shows the interior of the same shed. Each house is 8 ft. long by 6 ft. wide, the front is closed up halfway with iron and an aperture 4 in. wide is left under the roof at the rear of the shed for ventilation purposes. The floor consists of a large wire-netted frame (1 in. mesh) which can be pulled out through a 3½ in. gap allowed at the front of the shed (3 in. above ground level). The use of this system of flooring allows of cleanliness and prevents losses due to smothering. The shed is equipped with four roosts supported 9 in. above the wire-netting, and the birds will commence to roost a few nights after being placed in the sheds.

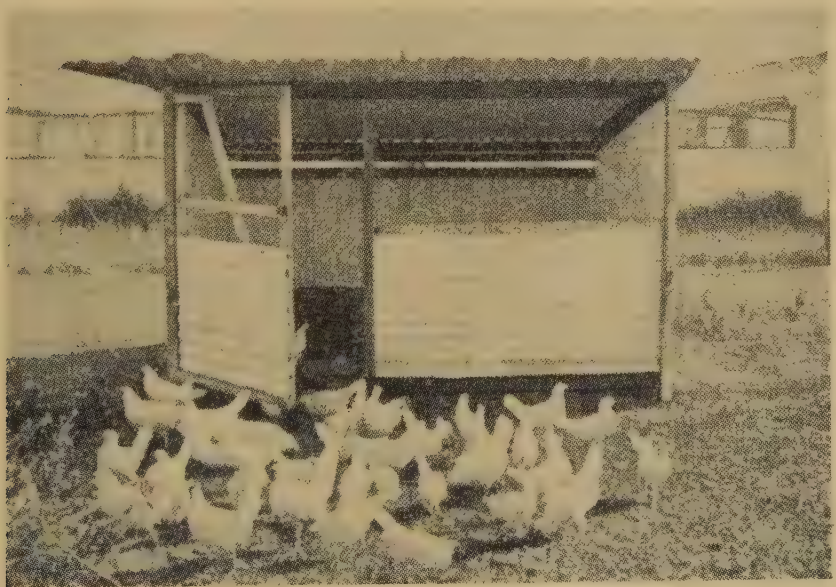


Fig. 13.
Rearing shed in use at Parafield Poultry Experiment Station.

Fig. 14.
Interior of shed.

The rearing grounds must be reserved for the young stock and must be kept vacant until required the next season. Shade trees should be planted in the yards as the birds will be in occupation during the warm weather. It is desirable to cultivate the yards and grow a crop of green feed which will be ready when the young stock are moved into the rearing sheds. This will aid in freshening the ground and provide additional green feed.

It was mentioned previously that it was necessary to build temporary yards around free range colony houses, and with restricted type of colony rearing it is also necessary to follow that procedure and to lock the birds in the house for the first week or so to prevent the young stock camping in the yard.

The Feeding of Chickens.

The system of feeding young chicks should be similar to feeding methods to be adopted when they become adult stock. It is general practice in Western Australia to use a mash and grain system and this appears to be suitable for most conditions. Many poultry farmers raise their chicks on dry mash and grain and at a later stage transfer to wet mash in the morning, dry mash in hoppers always available and grain in the evening. This procedure has given good results and can be regarded as a mash-grain system. Dry mash feeding reduces labour to a minimum, and pellet feeding, though very satisfactory, is at present rather expensive for general use.

Whatever the system of feeding adopted, it must be remembered that wholesome, highly digestible food is essential and must be given regularly, and no rapid changes of feed must take place.

The equipment used for feeding and watering the chickens must be kept scrupulously clean, and of such a type that the chicks cannot pollute the water or feed. There are several different types of these utensils on the market and as the majority are based on practical experience it should not be difficult to purchase suitable equipment. It must be understood that day old chicks will require feeding and watering utensils suitable to their size, and as the chickens grow larger, the utensils must be replaced by larger ones. Water vessels should be cleaned and filled with fresh water daily. Plenty of feeding space at the hoppers is essential; the circular hopper appears to be more satisfactory than the straight sided one in this regard. The ideal hopper should enable the chickens to feed easily, prevent waste, and be sanitary. It is good practice to mount the water fountains and feed hoppers on frames covered with ½ inch mesh wire. Spilled water goes below the wire and chicks do not come into contact with damp litter, and chicks are prevented from picking up small quantities of mash which may be spilled from the hopper and contaminated with droppings.

In the past opinions have varied considerably as to when the chick should receive its first feed, and it was considered advisable to delay feeding for 36 to 48 hours after hatching. There is no evidence to support this theory but experiments and practice indicate that the chicks may be given feed as soon as they have settled down in the brooder. If the chicks have been received from a hatchery they may be many hours old and water, shellgrit, and feed should be made available immediately, but it will be noticed that only some of the chicks will eat and it may be many hours before all the chicks will have eaten their first feed. Chicks may be fed in hoppers from a day-old but it is advisable to place additional dry mash on brown paper for the first day or two. A chick naturally picks at a light coloured object and as the feed shows up on the dark background of the paper it is not long before all the chicks are picking at the feed.

Chick rations should be well balanced and contain all the essential nutrients in the correct proportions because the chick eats and drinks frequently as its crop is too small to store a large amount of food, and the mixture used must be such that it is unlikely to give rise to digestive troubles. If very finely ground materials are used in a dry mash, and the materials are of such a nature that they stick together when damped then the materials may bind together forming a hard pad on the inner surface of the beak, and balling of the food may occur in the digestive tract retarding the work of the digestive juices, and causing digestive disturbances. If quick growth is required the rations should supply as much food in excess of that required for maintenance as the bird can eat, therefore the mash must not be excessively bulky.

If chicks receive grain during the first four weeks, growth is retarded because the consumption of mash containing the necessary proteins, vitamins and minerals is limited and they are practically forced to consume an unbalanced ration.

Composition of Chick Rations—Use of Oats.

In Western Australia it has been common practice to compound the chick mashes from wheat offals with meatmeal and buttermilk as the supplementary proteins. Is this practice in the best interest of the industry?

Biester and Devries in "Diseases of Poultry" have collected some interesting data on feeding oats to promote growth in chickens. They state that "some of the cereal grains are more effective than others in promoting growth and normal tissue structure in chickens. Chicks fed diets made up with single cereal grains, a single source of supplementary protein, and with appropriate

vitamin and mineral supplements, varied widely in both body growth and quality of feathering. It has been found that chicks fed on oats and milk diet grow more rapidly than those which are fed wheat and milk or barley and milk, but a combination of barley and oats proved to be fully as effective as oats alone.

Chicks may be reared successfully on diets made up of oats and milk with proper vitamin and mineral supplements when oats make up as high as 80 to 85 per cent. of the total diet. It has been found that ground oats in the diet are more effective than hulled oats which were formerly considered the superior feed. In experiments on rate of growth in chicks, it has been found that the chicks fed ground whole oats will invariably grow faster, followed by those fed barley, wheat and corn in the order named. Fig. 15 shows the rate of growth of chickens fed on an oat diet compared to growth on other cereals.

While wheat is a very good source of poultry feed, it should not be fed in unrestricted quantities, since there are reports indicating that chicks fed on high wheat diets grow slowly and with a high percentage of mortality.

When oats are used, the proportion of hulls does not seem to affect the result greatly, provided the weight of the oats exceeds 24 lbs. per bushel. As a result of this work, it is recommended that a mixture of grains should be used in making up a diet for chicks, and that gristed whole oats should be included in the mash.

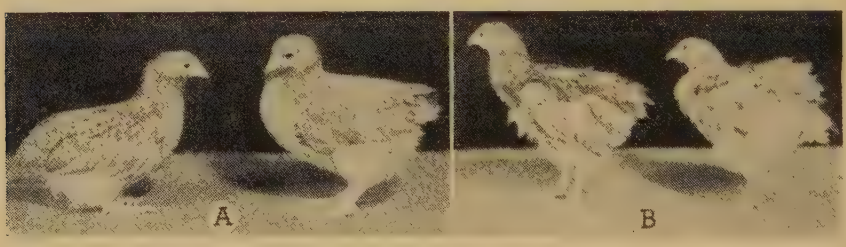


Fig. 15.
A.—Chicks fed a diet of ground whole oats, dried skim milk and mineral and vitamin supplements.
B.—Chicks received a diet of corn, dried skim milk with similar supplements. Both diets were fed at the same level of protein.

From the above information it would appear that in making up a chick ration whole gristed oats should be included to promote rapid growth. There is, also, another aspect of oat feeding which should be considered for it is based on recent research work by T. Barton Mann and published by the Cambridge University Press in the Journal of Agricultural Science. His work shows how profoundly mortality from bacillary white diarrhoea (pullorum disease) is affected by the kind of food fed to chickens. The work indicates that the most speedy method for the eradication of bacillary white diarrhoea is a combination of blood testing and nutrition and that foods capable of producing intestinal putrefaction must be withheld from the diet of chicks, and growing stock. With regard to foods: chicks should receive crushed grain for the first feed and thereafter for 72 hours to encourage an acid digestive tract. Foods containing processed proteins should be introduced to the diet in a gradual manner in order to give the chick an opportunity to acquire immunity to the organisms which these foods encourage, and such foods should not be fed in excess. After the introduction of these foods, gristed oats should be supplied for one complete feed of the day in an endeavour to produce one period in the 24 hours in which an acid reaction obtains throughout the whole length of the alimentary canal.

Abundant succulent green food should be supplied as a source of vitamins for protective factors. If an all-mash diet is fed, it is the opinion of that research worker that the protein content should not exceed 14 per cent. and the supplementary protein should consist mainly of milk.

The feeding tests on day-old chicks, carried out by this research worker, demonstrated the high mortality which occurred when National Baby Chick Mash (Protein 20 per cent.) formed the sole diet and the low mortality when gristed oats were substituted for one feed of mash and which lowered the total protein intake to 14 per cent. Provided they were given access to pasture at an early age, the chicks made steady growth and after the introduction of lowered protein feeding and a higher intake of green food, mortality from bacillary white diarrhoea declined.

The following is an extract from one of the feeding tests and is most interesting. The day-old chicks were fed National Baby Chick Mash obtained from two different manufacturers and it was fed as the first feed to the chicks in compartments one, three, four and six in the brooder house. For the chicks in compartments two and five the gristed oats were mixed with the National Baby Chick Mash and it was noticed that they were able to select the oats because of their size in the mash. One group of sister pullets was placed in compartment eight immediately after the previous tenants, the surviving chicks of a previous experiment had been removed (mortality had been 76.6 per cent.). The brooder was not disinfected and the only attempt at hygiene was to change the chaff litter. These day-old pullets received crushed oats only as the first feed and thereafter for 72 hours followed by N.B.C.M. for two feeds a day and crushed oats for one feed per day. Table I is an extract from a table showing the per cent. of mortality as influenced by oat feeding.

Table I.

Compartment No.	N.B.C.M. Source.	Details of Feeding.	Total Protein Intake.	No. of Chicks.	Deaths to 8th Day.	Mortality.
			%			%
1	A.	N.B.C.M., 2 feeds per day; crushed oats, 1 feed per day.	14	53	15	28·3
2	A.	Crushed oats 40% mixed with N.B.C.M., 60%, 3 feeds per day	16	53	11	20·7
3	A.	N.B.C.M., 3 feeds per day ...	20	78	61	78·3
4	B.	N.B.C.M., 2 feeds per day: crushed oats, 1 feed per day	14	53	22	41·5
5	B.	Crushed oats 40% with N.B.C.M. 60%, 3 feeds per day	16	53	14	26·4
6	B.	N.B.C.M., 3 feeds per day ...	20	54	36	66·7
8	A.	Crushed oats first 72 hours, then crushed oats 1 feed per day; N.B.C.M., 2 feeds per day	14	58	1	1·7

The research work carried out by T. Barton Mann indicates that chick rearers in Western Australia should include a proportion of gristed oats in the mash in an endeavour to reduce the incidence of pullorum in chickens. Statistics compiled from official records by the Government Statistician disclose that the yield from the principal grain crops of Western Australia for the 1945-46 season was approximately 21 million bushels of wheat, four million bushels of oats and 666,000 bushels of barley.

The export of wheat from Western Australia for 1945-46 was approximately 13½ million bushels so the difference between production and export for that year was 7½ million bushels. However, this amount would be for all purposes and it is probable that the wheat available for stock feeders would approximate the oat yield for the year. From the figures given it would appear that it should be possible to substitute oats for a portion of the wheat used by the poultry farmer.

Level of Protein in Chick Rations.

Protein levels and sources for both growth and egg production have been investigated by many research workers and there appears to be a general agreement as to maximum and minimum levels. The maximum being the level above which no further response can be expected and the minimum below which development is appreciably retarded. A review of the data available indicates that the maximum is approximately 21 per cent. and the minimum 13 to 14 per cent. for chickens in the first six to eight weeks of their growth, but maximum growth in pullets is not necessarily the most satisfactory growth.

Research work in the level and source of protein in poultry production as related to economical production of growth in pullets was undertaken by Gutteridge, O'Neil and Pratt of the Poultry Division, Experimental Farms Service, Department of Agriculture, Ottawa, Canada and results of their investigations have been published in "Scientific Agriculture." They point out that "From a physiological standpoint the greatest body weight in a given time may not mean the production of the most sound individual. Under these conditions, moreover, the feeds may not be used as efficiently for the production of gain in weight. In addition, rapid growth may be occasioned at a greater cost in consumption of feed containing high priced ingredients than the value of the increased weight of the bird would merit." A summary of their work to determine the comparative efficiency for rearing chickens on different levels of protein from vegetable or animal sources averaging approximately 12.5 per cent., 14.5 per cent., and 17 per cent. can be stated as follows:—12.5 per cent. of protein was too low and that, with reasonable supplementation by pasture, the medium level closely approximated the highest level in results, actually surpassing it with respect to efficiency of use of protein and economy of production of body weight. It was further determined that a level of 14.5 per cent. of protein gave equally as satisfactory results as those from a 16.5 per cent. level during the period of egg production following. From the points of view of growth and efficiency of utilisation vegetable proteins were inferior to animal proteins. Mortality was consistently higher on all levels of vegetable protein but, in general, the results obtained were reasonably satisfactory, and in time of scarcity of suitable animal proteins they could become useful substitutes.

The final summary on these experiments stated: "In consideration of the results obtained as judged by all the above criteria, it is concluded that feeding a 15.5 per cent. protein mash to seven weeks followed by a systematic reduction of protein by dilution with scratch grain so that a ratio of 3 parts grain to 1 of mash (13.7 per cent. protein) was reached at 24 weeks (average protein ingestion of 14.5 per cent.) may be expected to give as satisfactory results as the usual practice of 20 per cent. to 14.75 per cent. with a 17 per cent. average when pasture is available."

Table II is an extract from tables showing the schedule of feeding and protein levels actually consumed considering both grain and mash (15.95 per cent. protein). The scratch grain used in this experiment was a mixture of wheat, cracked

corn, oats, barley, buckwheat, sunflower seed and milo maize, which analysed 12.93 per cent protein. Protein supplements of the mash were meatmeal, fishmeal, and dried skim-milk.

Table II.

1– 7 weeks inclusive	... ...	Mash only	15·95% protein
8–10 „ „	... ...	4 parts mash : 1 part grain ...	15·35% protein
11–13 „ „	... ...	3 parts mash ; 1 part grain ...	15·19% protein
14–16 „ „	... ...	2 parts mash ; 1 part grain ...	14·94% protein
17–19 „ „	... ...	1 part mash ; 1 part grain ...	14·44% protein
20–22 „ „	... ...	1 part mash ; 2 parts grain ...	13·94% protein
23–24 „ „	... ...	1 part mash ; 3 parts grain ...	13·68% protein
Average	... ...		14·69% protein

The object in citing these several experiments is an endeavour to demonstrate that recent research indicates a better method of feeding day-old chicks than is common practice in Western Australia today, and that it is possible to rear healthy, well grown chicks with the feeds available in spite of the shortage of meatmeal.

In practically every country where oats are grown it has been the practice to include a percentage of oats in poultry feeds but the use of that grain has probably not been considered in Western Australia because of the quantity of wheat always available. However, with the suggested feeding of chicks which is given below it is necessary that the chicks be allowed out on pasture as early as possible, or that they be given an abundance of succulent green stuff at an early age. Greenfeed should be given to chicks when they are four or five days old as it will be two or three days before they will eat readily of this feed. The schedule of feeding is—

(*a*) 1–3 days inclusive ... ... Gristed oats.
(*b*) 4 days to 8 weeks inclusive ... Dry mash, plus 1 feed of gristed oats, plus greenfeed.
(*c*) 9 weeks to 24 weeks ... ... Wet mash in the morning, plus dry mash in hoppers, plus 1 feed of grain, plus greenfeed.

Explanation—

(a) The oats should be crushed sufficiently that they break up to allow the small chick to feed easily.

(b) Dry mash is placed in one feed hopper and is available to the chick for the greater part of the day. Gristed oats are placed in another feed hopper which remains closed for most of the day. When the attendant visits the brooders in the evening, after all the chicks are under the brooders, he closes the gristed oat hopper and opens the mash hopper, so that the mash will be available to the chicks when they come out in the morning.

As stated previously, chicks feed many times in the day and it must be the object of the attendant to close the mash hopper and open the one containing gristed oats at such a time that the chickens will consume gristed oats for their last feed prior to the greenfeed which should be the last feed of the day. It is not possible to state the exact time for the opening of the gristed oat hopper but it would be approximately 3 p.m.

The mash should be made up as follows:—

Table III.

Foodstuffs.	Amount by Weight.	By Volume Kero tins.	Crude Protein.	Calcium.	Phosphorus.
	lbs.				
Wheatmeal	32	1—⅓	3·2	0·01	0·06
Bran	30	2—½	4·2	0·02	0·18
Gristed Oats	30	1—⅔	2·7	0·01	0·06
Meatmeal	8	—⅓	4·0	0·64	0·32
Dried Buttermilk	4	—⅓	1·4	0·05	0·04
Bonemeal	2	...	0·4	0·40	0·24
	106	6—⅙	15·9	1·13	0·90
100 lb. contains	...	...	15·0	1·07	0·85

The mash consumed by the chicks during the day has a protein content of 15 per cent. but the last feed of the day of crushed oats has a protein content of nine per cent. The probable intake of feed would be in the ratio of four of mash to one of crushed oats and this would result in a total intake for the day of approximately 14 per cent.

It must be again emphasised that abundance of succulent greenfeed must be provided, and it must be realised that the protein intake from this source has not been taken into account.

(e) For this stage of the rearing two methods of procedure are possible but the one chosen must conform to the feeding system the pullets will receive during their laying life. If the system of feeding on the farm is dry mash the growing chickens should be allowed free access to the mash hoppers throughout the day. The crushed oats, previously given as the last feed of the day, can now be replaced by a scratch grain mixture containing equal quantities by volume of wheat and oats. That is, one bushel of wheat should be mixed with one bushel of oats, and the growing stock should be fed an amount they will clean up within half an hour. As standard weight of the bushel of wheat and oats are respectively 60 and 40 lbs. this grain mixture will be approximately in that proportion and will have a crude protein content of about 9.6 per cent. As there is a rapid increase in food consumed in the period when chicks are seven to ten weeks old it is reasonable to expect that the ratio of mash to grain will be three of mash to one of grain, and the protein intake for the day would be 13.65 per cent.; which figure does not include the protein contained in the greenfeed. The importance of rearing the growing stock on pasture or feeding ample supplies of greenfeed must be again stressed.

The amount of food consumed per chick per week is interesting, namely:—

Age in weeks	1	1–3	3–7	7–10	10–15	15–20	20–24
Food in ozs.	2	3	6	15	19	24	22

If the system of feeding the laying flock on the farm is the one popular in Western Australia, that is wet mash in the morning, dry mash in hoppers and always available, and wheat followed by greenfeed in the afternoon, then the growing pullet from nine weeks onward should receive a wet mash in the morning. The wet mash should consist of equal parts by volume of chaffed

green stuff and the mash mixture, and should be damped with water or skim-milk to the proper consistency. During the day dry mash should be available in the hoppers and the grain mixture, previously described, fed in the afternoon and followed by greenfeed.

Finally, the authors hope that the practical suggestions advanced and the review of recent research work may be of some assistance to poultry farmers. In all stock raising, environmental conditions may change the method or procedure, therefore the contents of this article must be used as a general guide and may be varied according to special circumstances.

REFERENCES.

McArdle, A A.: Practical suggestions for Poultry Farming. Bulletin No. 365, 1943. Department of Agriculture of South Australia.

Tabart, R. M. and Pulsford, M. F.: Poultry Bulletin No. 24 (Revised) 1945. Department of Agriculture, Tasmania.

Briester, H. E. and Devries, L.: Diseases of Poultry. The Iowa State College Press, 1945.

Halnan, E. T.: Scientific principles of poultry feeding. Bulletin No. 7. Ministry of Agriculture and Fisheries, 1944.

Barton Mann, T.: Chick rearing V. The influence of diet on epidemic bacillary white diarrhoea. Journal of Agricultural Science, 1945.

Tetanus in Farm Animals.

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THE disease tetanus occurs in practically all of the animals and man. It is caused by the tetanus bacilli (*clostridium tetani*) and results from contamination of wounds and raw surfaces with material such as earth or dust containing these organisms.

The tetanus bacillus is widely distributed in nature and frequently occurs in the soil of cultivated land, in stock yards and in animal manure. Upon gaining access to a wound tetanus bacilli show no tendency to invade the body by way of the blood circulation and set up a general infection, but remain localised at the site of infection where they multiply and in the process elaborate an extremely potent toxin. Tetanus toxin is one of the most powerful of the known poisons. It has a special affinity for nervous tissues by which it is readily absorbed and which it stimulates to produce the spasmodic muscular contractions so characteristic of the disease. The tetanus bacillus is an anaerobe which thrives in the absence of air. Consequently deep punctured wounds from which air is excluded are more dangerous than large superficial ones. Any wound, however, may become infected and particularly if it contains dead or necrotic tissue or has become covered over by accumulated discharges and scabs. The incubation period of the disease, i.e. the period which elapses from the infection of the wound until the appearance of symptoms, ranges from 3 to 21 days but is usually about 7 days.

Of the domesticated animals the horse is the most susceptible but under the conditions which obtain in Western Australia the most frequent and most serious losses from the disease occur amongst sheep. Cases occurring in horses are for the most part isolated ones and are sometimes a sequel to nail punctures in the feet, stake wounds, harness galls, or castration. Amongst sheep mortalities involving the loss of a considerable number of animals are from time to time encountered and are generally associated with marking and shearing. The disease occurs much less frequently in cattle and pigs. The mortality rate is high; 75 to 80 per cent. of horses and cattle which become affected die of the disease while in the smaller animals such as sheep and pigs, recovery rarely occurs. Treatment of the disease is not usually attended by satisfactory results and is only worth attempting in horses and cattle.

As a means of preventing the disease attention should in the first instance be directed towards the adoption of "clean" methods in connection with lamb marking, castration and other operations. This will involve the use of clean temporary yards, the sterilisation of instruments by boiling before use, and the observation of antiseptic precautions. Since the wounds may, however subsequently become contaminated by earth or dust from sheep yards or paddocks, these precautions will not necessarily provide an adequate safeguard against infection and on properties where tetanus is prevalent some more reliable method of prevention should be employed.

The most effective and practical method of preventing the disease is provided by vaccination with tetanus toxoid. Inoculation with this product produces a strong and lasting immunity which develops after an interval of 10-14 days from the time of injection and will protect the animal against the disease should it subsequently become exposed to infection. Tetanus toxoid is especially valuable for the prevention of outbreaks of tetanus associated with shearing. Resort may also be had to the use of tetanus anti-toxin. In contrast with the enduring active immunity conferred by tetanus toxoid, the passive or borrowed immunity resulting from the injection of tetanus antitoxin is of short duration, lasting only two to three weeks. Its effects, however, are immediate and if given at the time when the wound is inflicted it will tide the animal over the danger period while healing is occurring.

TETANUS IN SHEEP.

The majorty of the outbreaks of tetanus which occur in sheep are associated with marking or shearing and result from the infection of castration, tailing and shear cut wounds. Such mortalities may be serious resulting in the death of a considerable number of animals. In new-born lambs infection of the navel cord may take place before healing has occurred. In a few isolated instances mortalities from tetanus have been encountered in sheep following upon inoculation with vaccines for the prevention of other diseases. Such mortalities may be attributed to careless methods including the contamination of vaccines exposed in open containers, to dust containing tetanus spores or failure to sterilise syringes and needles before use.

Symptoms in Sheep.

With the onset of symptoms the gait becomes stiff and stilted and the animal is soon unable to stand. Sheep affected by tetanus are almost invariably found stretched out on their sides with the legs rigidly extended and the head and neck bent backwards (but sometimes downwards or to one side). Characteristically the muscles are in a condition of rigid contraction and the body is stiff and board-like. This will be particularly noticeable upon lifting the affected animal from the ground. In many cases due to contraction of the masticatory muscles the jaws are locked together and the mouth cannot be

opened, this condition being known as trismus or "lock-jaw." A moderate amount of tympanitis or bloating is a constant feature of the disease. Tetanus in sheep is almost without exception, fatal, death occurring within a few days from the appearance of symptoms.

A lamb affected by tetanus following marking. Note the rigidity of the limbs and the retraction of the head and neck.

Prevention.

Hygienic precautions.—Since the disease results from the contamination of wounds with tetanus bacilli or spores contained in the soil, hygienic precautions should always be adopted whenever the likelihood of such infection exists. These will be particularly applicable in connection with lamb marking. Old sheep yards which are likely to be heavily contaminated should be avoided and marking operations should be conducted in a well grassed temporary enclosure, erected in a convenient corner of the paddock, from hurdles or other suitable material. Instruments should be sterilised by boiling before use and when not actually in use they should be placed in an antiseptic such as a 2 per cent. solution of lysol (lysol 1 fluid ounce, water 2½ pints). Following marking, lambs should be set down carefully so that the wounds do not come into contact with the ground. Prior to the commencement of shearing, sheds should be given a thorough cleaning and shearcuts should be dressed with tincture of iodine. Following shearing or marking, sheep should be released into clean, well grassed paddocks. Since infection of the wounds may subsequently occur in yards or paddocks by contamination with earth or dust, the application of hygiene precautions may not always succeed in preventing the disease and upon properties where recurrent losses from tetanus have occurred, other methods of control must be employed.

Immunisation with Tetanus Toxoid.

Vaccination with tetanus toxoid provides the most effective means of preventing the disease. Inoculation with this product confers upon the treated animal, a strong and lasting immunity which develops after an interval of

about 14 days from the time of injection. The dose of tetanus toxoid for the sheep is 1 c.c. given subcutaneously (beneath the skin) and the cost of treatment is approximately a penny per head. Tetanus toxoid will be found especially valuable for the prevention of outbreaks of tetanus associated with shearing. Vaccination must be completed not less than 14 days prior to the date upon which shearing it timed to commence and may thereafter be relied upon to afford a high measure of protection.

Tetanus toxoid might also be employed for the protection of lambs following marking. Since lambing, however, is usually spread over a period of six to eight weeks during which time lambs are dropping irregularly and vaccination must be carried out at least 14 days in advance of marking, this method of prevention may not generally be found practicable.

Tetanus Anti-toxin.

Alternatively lambs may be protected against the disease by the injection of tetanus anti-toxin given at the time when marking operations are performed which will immediately provide them with a passive immunity of two to three weeks' duration. Tetanus anti-toxin is a serum prepared from horses which have been immunised by repeated injections of tetanus toxoid. Blood from such immunised horses is drawn from the jugular vein into a sterile container and allowed to stand for 24 hours. The clear fluid or serum which separates upon standing is drawn off, suitably preserved, and standardised. This serum contains immune bodies or anti-bodies which are able to neutralise tetanus toxin. The immunity conferred by tetanus anti-toxin becomes effective within a few hours after the injection of the serum but it is of short duration lasting only two to three weeks. It is a passive immunity which will last only until the anti-toxin has been eliminated from the body. It, however, serves to protect the animal during the period while the healing of the wound is occurring.

The dose of tetanus anti-toxin for sheep and lambs is 100 units (U.S.A.) given subcutaneously. In order to obtain accurate dosage it is necessary that the required dose (100 units) of anti-toxin shall be contained in a given amount —say .5 c.c.—of serum and whenever the immunisation of lambs with this product is contemplated it is necessary to make special arrangements with the Commonwealth Serum Laboratories who supply the serum to put it up in such a form that the above requirements will be fulfilled.

If it is desired to prolong the duration of the immunity simultaneous inoculation with tetanus anti-toxin and tetanus toxoid may be practised 100 units of anti-toxin being injected beneath the skin of the thigh on one side and 1 c.c of toxoid being injected into the opposite thigh. By this means both an immediate and enduring immunity will be obtained which should protect the lamb from any ordinary infection to which it may become exposed and should tide it over the first shearing.

TETANUS IN THE HORSE.

Tetanus in horses is most frequently associated with wounds of the lower portions of the limbs such as nail punctures in the feet or penetrating wounds caused by stakes and other objects. The disease is a not infrequent sequel to castration particularly when this operation is performed in stable yards. It may also result from the infection of saddle and harness galls and other surface wounds.

Symptoms in the Horse.

As in the other animals, tetanus in horses is characterised by spasmodic contraction and stiffening of the body musculature. This usually commences in the muscles of the head and neck but rapidly extends to other groups of muscles. In an advanced case the affected animal stands stiffly with the forelegs spread widely apart; the neck is extended, the tail is held rigidly and somewhat elevated and the abdomen is tucked up. The nostrils are dilated and trumpet-like; the ears are erect and the lips are drawn back exposing the teeth. Protusion of the membrana nictitans (third eye-lid or haw) from the inner corner of the eye is a characteristic feature of the disease and this will become very pronounced when the head is elevated by a hand placed beneath the lower jaw. Affected animals feed slowly and seem to have difficulty in swallowing. In many cases due to contraction of the masseter muscles the mouth cannot be opened and although the appetite remains good the animal is unable to feed. This closure of the jaws is known as trismus. The muscles of the body are hard and board-like to the touch and this will be very apparent when the hand is placed upon the rump of the affected animal. The animal moves with a stiff straddling gait and has great difficulty in turning and backing. The joints are stiff and can only be flexed by the application of considerable force. Horses affected by tetanus are very sensitive to sound and light and when suddenly disturbed the muscle spasms may be increased to such an extent as to cause the animal to fall to the ground. The mortality rate is very high, the disease terminating fatally in from 75 to 80 per cent. of cases. Death usually occurs in from 3-10 days but should the animal survive for a fortnight the prospects of ultimate recovery are reasonably good.

A horse affected by tetanus.
(After Hulyra and Marek.)

Prevention.

In localities where tetanus is prevalent, wounds should receive special attention and should be regularly cleansed and dressed with an antiseptic preparation. When operations such as castration are to be performed aseptic precautions should be observed. Instruments should be sterilised by boiling and the skin at the site of the operation swabbed with tincture of iodine. The

horse should be cast on a clean well grassed area, stock yards and stable yards being avoided. The injection of 500 units (U.S.A.) of tetanus shortly after a wound has been sustained or when an operation is about to be performed, will in most cases protect the animal from infection during the ensuing period of 2-3 weeks while the wound is healing. As in the case of sheep, vaccination with tetanus toxoid produces in the horse a strong and enduring immunity and this might well be adopted as a routine procedure on all properties upon which the disease occurs. The dose of tetanus toxoid for the horse is 10 c.c. given subcutaneously. A second injection of 10 c.c. given after an interval of a year will confer upon the animal a life-long immunity.

Treatment.

The treatment of tetanus in horses does not offer very favourable prospects of success. In the first place the wound should be sought and thoroughly disinfected. All discharges and dead or necrotic tissue should be removed and this should be followed by regular dresings with an antiseptic such as tincture of iodine. The animal should be placed in a quiet dark loose box and disturbed as little as possible. The diet should consist of soft easily digested food such as green stuff, bran mashes or boiled oats or linseed. When the animal is unable to masticate, liquid foods such as thin gruel or sloppy bran mashes should be made available. The bowels should be regulated by the administration of magnesium sulphate (Epsom salts) in the drinking water.

Tetanus anti-toxin is sometimes used in the treatment of the disease but since this product can have no effect upon the toxin which has already combined with the nervous tissues and can only neutralise toxin which may continue to be produced at the site of infection, its value as a curative is extremely doubtful. Very large doses of anti-toxin repeated at frequent intervals must be employed and since this is expensive its use can only be justified in the treatment of very valuable animals. The treatment of the disease is always difficult and whenever possible veterinary assistance should be obtained. Some recoveries will occur with treatment but the outlook cannot be generally regarded as very hopeful.

TETANUS IN OTHER ANIMALS.

Tetanus is not very frequently met with in other animals. In cattle it sometimes occurs after calving when it may be associated with retention of the afterbirth or metritis (inflammation of the uterus), while in calves it may be a sequal to castration. The symptoms in cattle are very similar to those exhibited by horses and include general muscular stiffness, trismus (locking of the jaws), protusion of the membrane nictitans and bloating.

Tetanus is uncommon amongst pigs but may occur as a sequal to castration, and is rarely seen in dogs. In these animals the symptoms follow much the same pattern as those shown by other animals and the disease is nearly always fatal.

Rations For Laying Hens.

The Comparative Costs of Alternative Rations.

L. C. Snook—Animal Nutrition Officer.

IN the March issue of this Journal R. H. Morris, an officer of the Poultry Branch of the Department of Agriculture, described a comprehensive poultry feeding experiment now being carried out at Muresk Agricultural College. This experiment has been designed to answer some of the more urgent questions to which the poultry industry would like answers. Unfortunately the answers will not be obtained quickly, as poultry feeding experiments are essentially "long term" undertakings. Before a ration can be said to have proved itself it must be known to keep fowls in good health and steady production throughout the year. So rather than wait until the experimental results are available it may be helpful to describe the rations which were selected, and to explain why certain food mixtures were used. This will permit practical men to follow the experiment with greater interest. Possibly the rations themselves, along with the relative costs of the various mixtures, may prove useful as examples to those who are keen to prepare balanced rations at a minimum cost.

Before working out rations it is first necessary to know just what are the nutritive requirements of the laying hen. These requirements have been investigated very thoroughly right down to individual vitamins and the millionth part of trace elements such as manganese. Fortunately, the producer who feeds his birds the usual mixed rations, along with a reasonable amount of greenstuff, rarely has to worry about the lesser known essentials and in this article discussion will be limited to three major constituents:—protein, calcium and phosphorus.

Protein.

If fowls are to be kept in steady production the ration should contain about 12 per cent. of *digestible* protein, this to include a certain proportion of protein of animal origin. Meatmeal is in general use to supply this protein but where skim milk is available this forms an ideal supplement for poultry. The proteins in milk are of high quality and small amounts will often exert quite a beneficial influence. As a rough rule it may be taken that, where meatmeal is used, one fifth of the protein fed to the birds should come from the meatmeal.

Calcium.

Every farmer is aware of the great importance of calcium (or lime) in the rations of livestock. Laying hens, in particular, require ample supplies of this element for the production of good quality egg shells. This is shown by the fact that while growing chicks require about 1 per cent. of calcium in their diet, laying hens should receive about 2.4 per cent. in order to satisfy bodily needs and produce good quality eggs with sound shells.

Phosphorus.

For optimum results the ration of the laying hen should contain about 1 per cent. phosphorus. Cereal grains and their by-products are generally quite well supplied with phosphorus and for this reason most poultry rations contain

reasonable amounts of this element. It will be noticed, however, that a certain amount of bonemeal rich in phosphorus has had to be added to all the rations discussed in this paper.

TABLE I.

Foodstuffs for Poultry.

Cost and Nutritive Value.

Foodstuff	Cost in Perth, June, 1947.	Cost per 100 lb. (pence)	Protein per 100 lb.		Calcium (Ca) per 100 lb.	Phosphorus (P) per 100 lb.
			Crude.	Digestible.		
Wheat ...	6s. 2½d. per bushel of 60lbs.	124	10	8	0·04	0·22
Oats	4s. 5d. per bushel of 40 lbs.	132	9	7	0·05	0·22
Bran	£7 15s. 5d. per short ton	93	14	10	0·07	0·60
Pollard ...	£7 15s. 5d. per short ton	93	13·5	10	0·05	0·32
Peas	10s. per bushel of 60 lbs.	200	22	18	0·06	0·38
Meatmeal ...	£15 15s. per short ton	189	50	45	8	4
Bonemeal ...	£15 14s. per short ton	188	20	18	20	12
Ground Limestone	£4 10s. per ton	54	0	0	40	0

(These foodstuffs are assumed to contain 10% moisture.)

Composition of Foodstuffs.

Having listed the percentages of digestible protein, calcium and phosphorus required by laying hens, it is now necessary to know the quantity of each of these ingredients in the foodstuffs available. In Table I the approximate composition of various West Australian foodstuffs is recorded, along with the cost ex store, Perth, in June, 1947. It should be stressed that the quality of foods vary considerably from place to place, and from year to year, and that the figures given in any Table of Composition can serve only as a guide. In Table I, for example, oat grain is listed as containing 7 per cent. digestible protein but this is only an average figure: samples may contain as much as 11 per cent. or as little as 5 per cent. digestible protein. This variability is emphasised because there is a tendency to place undue reliance on Tables of Analyses and theoretical rations calculated therefrom. The correct procedure is to use Tables to check what appears to be a sound practical ration and then do as all good stockmen have done, judge the value of a ration by the results obtained. It will be noted that the ration Tables have been prepared in terms of "digestible protein." This is because the protein value of a food is determined by the fraction which the animal can absorb and not by the total amount of crude protein which may be present. The distinction may not be important to poultry keepers as most of the foodstuffs fed to laying hens have a high digestibility but it is good practice always to consider feeding stuffs in terms of their actual food value, that is, in terms of digestible food constituents.

The various rations fed to the experimental birds at Muresk are listed in Table II and will be discussed in order.

TABLE II. (*Rations for Laying Hens*)—Nutritive value and Cost.

Ration.	Foodstuffs Required.	Weight lb.	Cost pence.	Nutriant Supplied.		
				Digestible Protein.	Calcium (Ca)	Phosphorus (P)
I.	Wheat	50	62·0	4·0	0·02	0·11
	Bran	30	27·9	3·0	0·02	0·18
	Pollard	10	9·3	1·0	0·01	0·03
	Meatmeal ...	10	18·9	4·5	0·80	0·40
	Ground Limestone	3	1·6	0·0	1·2	0·0
	Bonemeal ...	2	3·8	0·4	0·4	0·24
		105	123·5	12·9	2·45	0·96
		100	118	12·3%	2·3%	0·9%
II.	Wheat	30	37·2	2·4	0·01	0·06
	Crushed Oats ...	20	26·4	1·4	0·01	0·04
	Bran	30	27·9	3·0	0·02	0·18
	Pollard	10	9·3	1·0	0·01	0·03
	Meatmeal ...	10	18·9	4·5	0·80	0·40
	Ground Limestone	3	1·6	0·0	1·2	0·0
	Bonemeal ...	2	3·8	0·4	0·4	0·24
		105	125·1	12·7	2·45	0·95
		100	120	12·1%	2·3%	0·9%
III.	Wheat	50	62·0	4·0	0·02	0·11
	Crushed Oats ...	20	26·4	1·4	0·01	0·04
	Bran	10	9·3	1·0	0·01	0·06
	Pollard	10	9·3	1·0	0·01	0·03
	Meatmeal ...	10	18·9	4·5	0·80	0·40
	Ground Limestone	3	1·6	0·0	1·2	0·0
	Bonemeal ...	3	5·6	0·5	0·6	0·36
		106	133·1	12·4	2·65	1·00
		100	126	11·7%	2·5%	0·9%
IV.	Wheat	80	99·2	6·4	0·03	0·18
	Cr. Peas ...	10	20·0	1·8	0·01	0·04
	Meatmeal ...	10	18·9	4·5	0·80	0·4
	Ground Limestone	3	1·6	0·0	1·2	0·0
	Bonemeal ...	3	5·6	0·5	0·6	0·36
		106	145·3	13·2	2·64	0·98
		100	137	12·5%	2·3%	0·9%
V.	Wheat	90	111·6	7·2	0·04	0·20
	Meatmeal ...	10	18·9	4·5	0·80	0·40
	Ground Limestone	3	1·6	0·0	1·2	0·0
	Bonemeal ...	3	5·6	0·5	0·6	0·36
		106	137·7	12·2	2·64	0·96
		100	129	11·5%	2·3%	0·9%
VI.	Wheat	60	74·4	4·8	0·02	0·13
	Oats	30	39·6	2·1	0·02	0·07
	Meatmeal ...	10	18·9	4·5	0·80	0·4
	Ground Limestone	3	1·6	0·0	1·2	0·0
	Bonemeal ...	3	5·6	0·5	0·6	0·36
		106	140·1	11·9	2·64	0·96
		100	132	11·2%	2·3%	0·9%

Ration I (Control).

The control ration in the Muresk experiments was selected as being similar to that which would be used by choice by a large number of poultry farmers. It contains 50 per cent. whole wheat grain and 40 per cent. mill offal, and lends itself to a variety of feeding treatments. At Muresk all the ingredients are mixed together and fed dry in a large self-feeder but where the use of a wet mash is preferred, the bran, pollard, meatmeal and minerals could be fed as a wet mash in the morning and the grain at night. As can be seen from the Table this ration is well balanced in nutrients and the cost (in Perth) of about 10s. per 100 lb. is very reasonable. All groups receive a kerosene tin of chopped green stuff per 100 birds per day. It is to be expected that the hens receiving the Control Ration should produce well and remain in good health.

Ration II.

The control ration has two obvious disadvantages—it consists mainly of wheat or wheat products, and it contains 40 per cent. mill offal which at the present time is difficult to obtain. In Ration II an effort is being made to determine if a mixture of wheat and oat grain is of more value than wheat grain alone. Most livestock feeders maintain that a mixture of cereal grains will always give better results than one grain alone. Wheat, for example, may be lacking in some factors which would be supplied by oats, and vice versa. It will be interesting to see if the birds in the second group do show any significant difference in production from those in Group I. From the point of view of cost, Ration I is preferable to Ration II.

Ration III.

At present prices bran and pollard are the cheapest foods a poultry farmer can buy but unfortunately the demand greatly exceeds the supply. It follows that rations containing little or no mill offal must often be used. In Ration III crushed oats have been used to replace 20 lb. bran. It will be seen from the Table that this change decreases the theoretical nutritive value of the ration and increases the cost. In practice, however, good quality oat grain may give quite good results. It should ease the position for country egg producers if oats are found to be a satisfactory substitute for bran and pollard.

Ration IV.

Many practical men are of the opinion that a ration consisting mostly of cereal grain is greatly improved by the addition of relatively small amounts of leguminous seeds. At present such seeds cannot be purchased as stock food but it should be possible for many poultry producers in the country to grow crops such as field peas, tangier peas, or vetches. Vetches, for example, now being studied by State and Commonwealth officers, have been found to yield well over a ton of seed per acre when grown in our wheat belt, and as these hardy plants are resistant to red mite and the pea weevil it might become profitable to grow these protein-rich seeds for poultry. There is some doubt, regarding the value for fowls of the protein in leguminous seeds. For this reason field peas (the only leguminous seeds at present obtainable in quantity) are being tested at Muresk. The ration is quite uneconomic at present prices but should leguminous seeds become available in the future it may be helpful to know something about their feeding value for laying hens.

Ration V.

In Ration V simplicity has been taken to its uttermost limit. The birds receive only whole wheat grain, meatmeal and a mineral mixture. Labour costs have been reduced to a minimum by feeding the grain in one large self-feeder and the meatmeal and minerals in another. Much of the success of this ration will depend on the quality of the meatmeal and for this reason alone, the results will be of considerable interest. Where greenstuff is available, a simple ration such as this should give quite good returns.

Ration VI.

An attempt has been made in this ration to relieve the monotony of Ration V by the replacement of 20 per cent. of the wheat with the same weight of crushed oats. Here again the object is to determine if a mixed cereal ration is more productive than one cereal alone.

General.

It is instructive to note that rations containing only wheat grain, or wheat and oat grain, are definitely more expensive than rations containing bran and pollard. This is a reflection of the high price at present commanded by cereal grains.

The percentage of meatmeal has been kept constant at 10 per cent. in all rations. This has been done purposely, so that the value of the other ingredients could be more easily compared. It is realised that meatmeal is difficult to obtain but it is probable that by the time the Muresk experiments have been completed normal supplies of this basic poultry food will be available.

Summary.

The rations used in the Poultry Feeding Trial now being conducted at Muresk Agricultural College have been tabulated so as to show the relative cost and nutritive value. At current prices the Control Ration (No. I) containing 40 per cent. mill offal is the most economical. The reasons for investigating variations of this apparently satisfactory ration are discussed.

Fodder Conservation in the Kimberleys.

W. M. NUNN, Agricultural Adviser.

IT has long been common practice in the agricultural areas of Western Australia, for farmers to conserve fodder grown in winter and spring months for feeding to stock during the long dry summer.

Cereal crops and clover and grass pastures are cut with the reaper and binder, or the mower, and stacked or ensiled for future use and in this way the short growing period is made to provide nutritious fodder to meet the needs of stock the year round.

If left to mature and dry in the paddock, clover and grasses still provide feed for grazing stock, but much of their food value is lost. Analyses of many species have shown that feed value is high in the young green plant, particu-

larly with regard to protein and vitamin content, and that these important constituents deteriorate rapidly as the plant dries off, to be replaced by a high proportion of indigestible fibre. Progressive farmers are careful therefore to conserve adequate supplies of fodder cut at or about the flowering stage.

Correctly conserved either as hay or silage, these fodders retain their high feed value and are fed to stock to ensure adequate rations when paddock feed is inferior.

In the Kimberley and North-West divisions stock are run over very extensive areas indeed. In the former, cattle predominate while the latter is devoted almost entirely to sheep, but in both divisions, the stock are grazed over tremendous areas of natural herbage, faring well in good seasons and poorly in bad.

The North, like the South, has its wet period and its dry each year. The rains, however, occur in the summer and an extended dry period is experienced while the South is receiving its regular winter rains.

In the North-West division rains, even in summer months, are unreliable, and over extensive areas the principal stock feeds consist of shrubs or of spinifex rather than of grasses which would be capable of conservation. In the Kimberleys however, summer rains are reasonably assured, and a growth of natural grasses occurs during the wet of most seasons.

For many years several stations in the West Kimberley area cut grass hay each year and stacked it either in the paddock or at the homestead. Being loose it lost most of its feeding value when being handled and fed to stock.

In 1945 Liveringa station purchased a hay baler and undertook the mowing and baling of natural grasses, and Mr. K. C. Rose, the manager, has kindly supplied the following information concerning the extent of the work and the results achieved.

Liveringa is a sheep station of 700,000 acres with a 70-mile frontage to the Fitzroy River.

Hay is brought to the baler by truck-drawn sweep.

The extent of operations has so far been limited by the machinery available, but working within 3 miles of the homestead in March and April of this year, 3,200 bales were cut. Bales averaged 60-lbs. each and the yield was approximately ½-ton per acre.

Thus about 90 tons of high-grade fodder was obtained, and Mr. Rose considers that it will pay handsomely to extend operations on a much larger scale when more modern machinery can be obtained. He estimates that 20,000 bales could have been cut this year within 10 miles of the Liveringa homestead.

Two mowers and a rake are pulled by motor truck. The grass is brought to the hay baler by a sweep which is also pulled by truck. The grass is then fed to the baler by hand.

The fodder cut this year was mainly wheaten grass, but flinders, button, rice and bundle bundle grasses were present in admixture.

Two views of the baler in operation on Liveringa Station.

At Liveringa, portion of the grass hay is chaffed for feeding with oats to horses and mules. The rest is fed as long hay to rams during November and December prior to mating, and to horses on mustering camps.

Bales of 60 lbs. are easy to stack and convenient for handling and carting to feeding points.

These uses are restricted in comparison with hand feeding programs carried out on farms in the agricultural areas, but it is a distinct start towards the more economic use of locally grown fodders, and the Kimberley Pastoral Co. is to be congratulated on the initiative shown in this direction. That the example is already being followed by other pastoralists, is evidenced by the fact that two other stations in the district have this year purchased hay balers. Their progress, as well as further advances on Liveringa, will be watched with great interest by all concerned with Kimberley development.

Sodium Fluoride for the Treatment of Worms in Pigs.

C. R. TOOP, Assistant Chief Veterinary Surgeon, Department of Agriculture.

In trials which were carried out in the United States in 1945 it was shown that sodium fluoride when administered in the feed was highly effective for the removal of large roundworms (*Ascaris lumbricoides*) from pigs.

Prior to that time a choice of two drugs, viz., oil of chenopodium and phenothiazine, had been available for this purpose. While the results obtained from the treatment with both of these drugs had been reasonably satisfactory, certain disadvantages had been associated with their use. At best the efficiency of these drugs did not usually exceed 60 per cent., leaving room for considerable improvement. Of the two, oil of chenopodium was the more reliable but suffered a disadvantage in that it was necessary to treat each animal individually, the drug being mixed with castor oil and administered as a drench by means of a sheep drenching gun or other suitable appliance. Treatment with phenothiazine was much easier since the drug could be given in the food and was readily consumed but on occasions

it proved unreliable removing only a small proportion of the worms harboured by the animals. Moreover, neither oil of chenopodium nor phenothiazine were effective against immature worms.

American publications which became available in 1945 indicated that sodium fluoride possessed a much higher degree of efficiency for the removal of roundworms than either of these drugs. In trials in which it had been administered in the ration at the rate of 1 per cent. for one day, it had succeeded in removing 97 per cent. of the large roundworms harboured by the treated animals. A note of caution was however, sounded. Since the drug possesses toxic properties it was emphasised that more extensive trials would be necessary before its use could be recommended.

Since this information became available sodium fluoride has been used in Australia with very satisfactory results. In this State trials on a limited scale have been carried out at the Muresk Agricultural College. Here its use has been confined to weaners in which a dosage of 5 grams (on sixth of an ounce) has been employed. In the case of individual animals in which it has been possible to check the results by post mortem examination enabling a count to be made of any worms remaining after treatment, the efficiency of the drug has always exceeded 90 per cent. and in more than half the treated animals it has reached 100 per cent.

Following upon the excellent results obtained from the treatment of single animals the treatment of all litters two to three weeks after weaning has been adopted as a routine practice. The drug is given thoroughly mixed in the ration (crushed wheat and meat-meal) at the rate of one ounce to every six pigs. In this dosage the mixture has been readily consumed and no ill effects other than occasional slight vomiting and the passage of soft faeces have occurred. In dealing with groups of pigs it has not been possible for economic reasons to check the efficiency of the treatment by post mortem examination but there is no reason to believe that it has not remained at a high level. In these experiments the drug has proved effective both against adult and immature worms.

Recently a report of some comprehensive field trials with sodium fluoride carried out at the Animal Health Station, Yeerongpilly, Queensland, has become available. These trials, in which nearly 300 pigs of all weights were involved, including breeding sows and boars, have established beyond any doubt the safety and efficiency of the drug in the treatment of worms in pigs.

From the information gained from these trials a table of dosage has been prepared and is reproduced hereunder for the guidance of those who may contemplate using this method of treatment.

DOSE RATES.

Live Weight of Pigs.	Number of Pigs to 1 ounce of Sodium Fluoride.
lb.	
20	14
21—40	7
41—60	4
61—80	3
81—100	2⅓
101—150	2
151—200	1½
Over 200	⅚

Prior to treatment the pigs should be graded into small groups (up to 10 animals) of even size and the amount of sodium fluoride to be administered in their feed computed on a weight basis by reference to the above table. This should be weighed and thoroughly mixed in an amount of food which will be consumed during the course of the day. According to Queensland observations an allowance of 1 lb. of the treated food mixture per 25 lbs. live weight is adequate. On this basis seven weaners averaging 35 lbs. would receive 1 ounce of sodium fluoride in about 10 lbs. of food material. This amount will usually be consumed during the day but should any remain uneaten it should be mixed with the evening feed.

This is a portion of the small intestine of a pig tightly packed with large round worms (*Ascaris Lumbricoides*). Treatment with sodium fluoride would have removed most, if not all, of the parasites.

In our experiments at Muresk the drug was given in a mixture of crushed wheat and meat-meal which was fed dry and was readily consumed. Any other grain or meal mixture fed dry or if necessary moist, would be found equally satisfactory.

In the treatment of large pigs, sows and boars, the dose of sodium fluoride should be divided, half being given in the morning and the balance in the evening feed. In the case of such animals the food is rapidly consumed and the indigestion of a full dose of sodium fluoride in a short space of time may provoke violent vomiting. This does not, however, occur when the dose is divided. It is usual to starve the pigs overnight (allowing no food on the previous evening) prior to treatment but this procedure is probably unnecessary. Following treatment worms do not usually make their appearance in the droppings until three or four days and may continue to be passed out until the eighth or ninth day.

In the Queensland trials the efficiency of sodium fluoride in all cases exceeded 90 per cent. when single animals were treated. In the group trials the efficiency was somewhat lower but it was still very satisfactory and averaged 82 per cent.

When the drug was given in medicinal doses no ill effects resulted apart from the passage of soft faeces and mild vomiting in a few cases. Amongst the large number of pigs included in the trials no deaths resulting from the treatment were

recorded. The gradual consumption of the treated food apparently provides an adequate safeguard against the toxic effects of sodium fluoride and in addition should an excessive amount of the drug be consumed, vomiting is induced which provides a further safeguard.

The information now available indicates that sodium fluoride when given in the recommended dosage is a safe and highly effective drug for the treatment of worms in pigs and its use is consequently advocated.

Agricultural Problems.

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district of the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

The addresses and names of Advisers are as follows:—

Albany	A. T. Gulvin, (Fruit)
Beverley	A. J. T. Marshall, (Court House)
Bridgetown	K. M. Simes, (Dairying): A. Flintoff, (Fruit)
Bunbury	N. R. McKeown
Busselton	A. L. Hamilton
Denmark	C. W. Tobin
Donnybrook	R. L. Cailes
Fremantle	N. Ingleton (Stock Office)
Geraldton	G. L. Throssell, (Government Buildings)
Gosnells, Kalumunda, Roleystone	W. P. Fears, (Kalamunda)
Kellerberrin	E. R. Watson, (Court House)
Manjimup	J. T. McNally, (Dairy): O. Hanbury, (Fruit)
Margaret River	V. B. Monti
Mundaring	V. Cahill

Routine Examination of Western Australian Butter for Micro-Biological and Chemical Content.

M. CULLITY—Superintendent of Dairying.

K. NEEDHAM—Officer-in-Charge, Dairy Laboratory.

Introduction.

SOME years ago biological examinations of Factory butters were carried out regularly by Griffen for a butter company in this State. Occasionally certain specific problems arising were investigated notably that on Rabbito by Cullity and Griffen ([1]).

It has also been the practice to examine butter taken from the grading floor in Perth in connection with the annual competitions conducted by the Institute of Factory Managers and Secretaries.

In November, 1944, it was possible to institute a regular examination for both biological and chemical content in the Dairy Laboratory of this Department. Due to difficulties associated with the war years, the service could not be extended to cover factory equipment nor the processes of manufacture, and, therefore, analyses were confined to samples taken on the Perth grading floor. Recently, preliminary surveys have been performed at a metropolitan factory covering the various stages of processing and it is intended to extend this service to all Dairy Produce Factories in the State.

The Value of Biological Surveys.

While there is little, if any, correlation between the micro-biological counts of butter and its grade, there are certain specific organisms which are associated with definite flavours.

It is not possible to predict the grade of a butter from an assessment of its biological condition, but a factory whose equipment is clean, and whose butter contains consistently few organisms, will be found usually to have a record of high quality.

The visible cleanliness of the equipment, apart from good biological condition, is an indication of care frequently extended to the technical processes of manufacture which also have their effect on good quality.

The need for freedom from pathogens of any foodstuff is obvious. Grading of butter cannot be expected to be of value in detecting samples likely to be injurious to health, but routine bacteriological examination does assist in showing the presence or absence of organisms of the Coliform groups which include forms causing disease.

Examinations therefore serve as a means of ascertaining the general level of hygiene in the factory and to a very limited extent the possible presence of pathogens of the coliform type.

Surveys of the equipment in the factories are valuable in locating points of contamination which can then be remedied.

The Micro-Biological Examinations Performed.

The examinations performed include counts for Total Bacteria, Yeasts and Moulds, as well as observations for the presence or absence of Coliform organisms.

The Total Count gives a reliable guide to the total micro-biological population of the sample, and the result provides an indication of the general standard of cleanliness of the factory equipment.

It is generally accepted that the Yeasts and Moulds Count is a guide to the cleanliness of the churn and for this reason, it is included as a routine test.

Many of the bacteria belonging to the Coliform group are pathogenic to man, and therefore, by making an examination for this particular group, some indication is given of the possible presence or absence of human pathogens. Furthermore, the presence of Coliform organisms may indicate inefficient heat treatment, cooling, or re-contamination.

Method of Sampling and Performance of Examinations.

Since November, 1944, an endeavour has been made to sample butter from each of the ten factories in the State at approximately three weekly intervals, and this has been achieved with some measure of success.

Samples are taken on the grading floor in Perth from five consecutive churnings, in order to gain some idea of the consistency of the method of manufacture employed over a period of time. A core of butter, taken from the box, is divided into three, and placed into sterile bottles. The samples are delivered to the laboratory with the shortest possible delay, usually not more than two hours. The incubation period for the Total Count and Yeasts and Moulds is five days at 22°C. and for the tubes for Coliform organisms, two days at 37°C. Reports are forwarded to the factory manager and to the District Departmental Officer who are then in a position to co-operate in solving any problems.

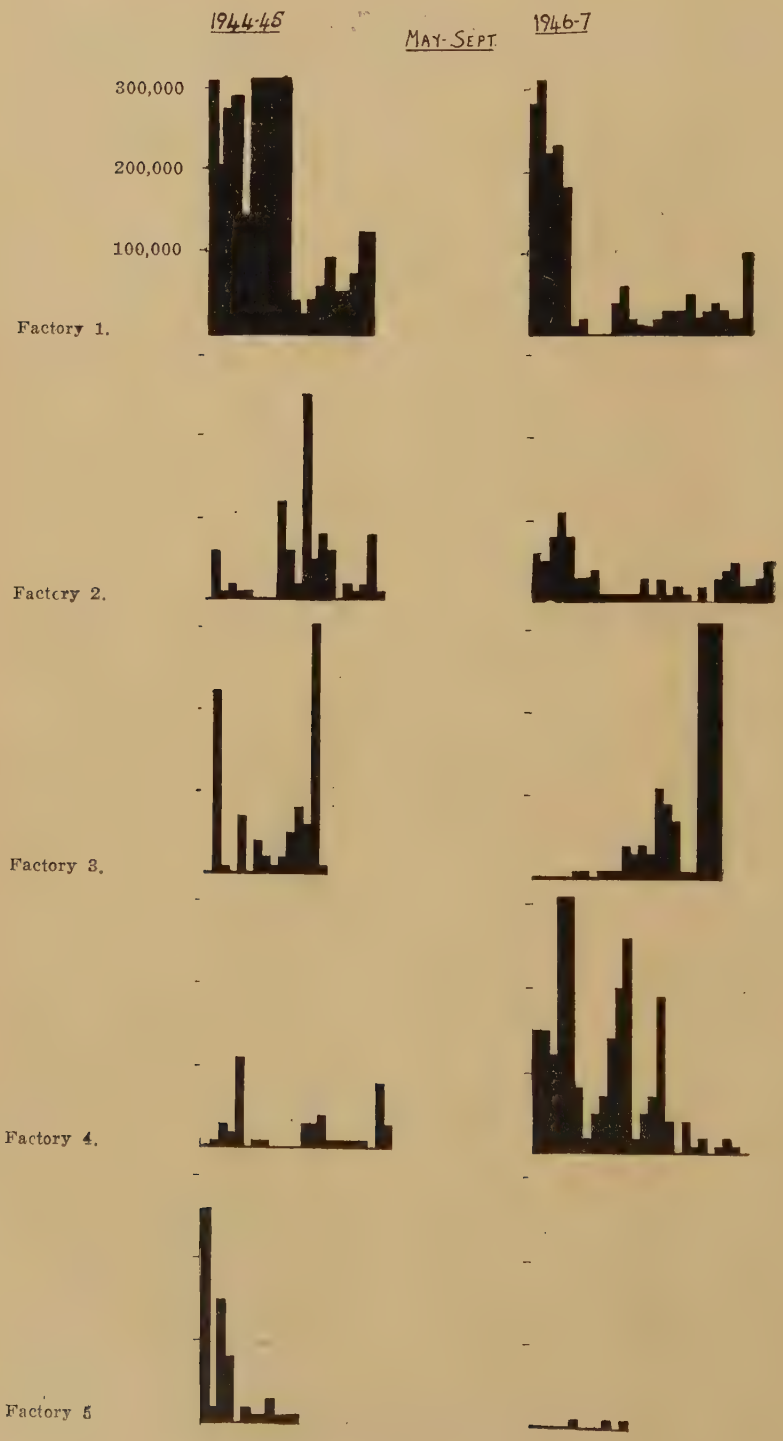
The basis of assessing the results is as follows: —

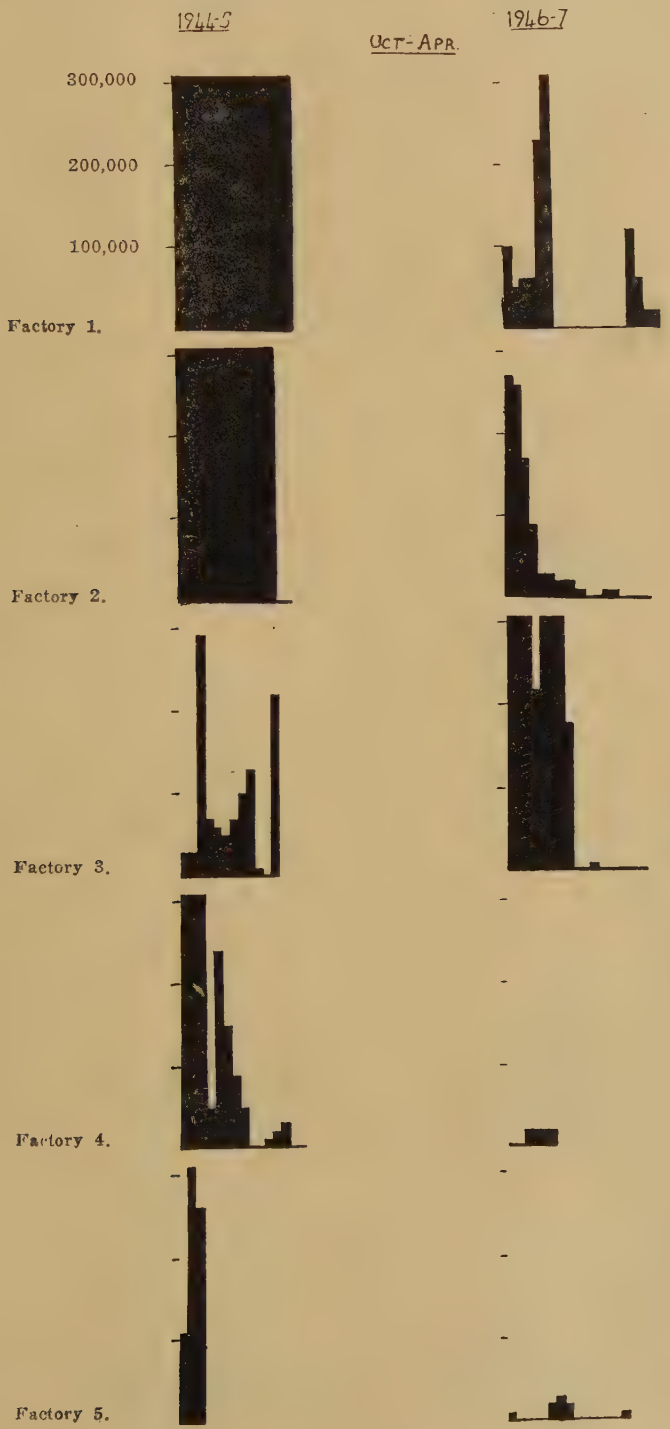
Total Count.		*Coliform.*		*Yeasts and Moulds.*	
Good	0—10,000	Negative	Satisfactory	Satisfactory	Below 50.
Fair	10—35,000	Positive	Unsatisfactory	Unsatisfactory	Over 50.
Poor	35—75,000				
Bad	Over 75,000				

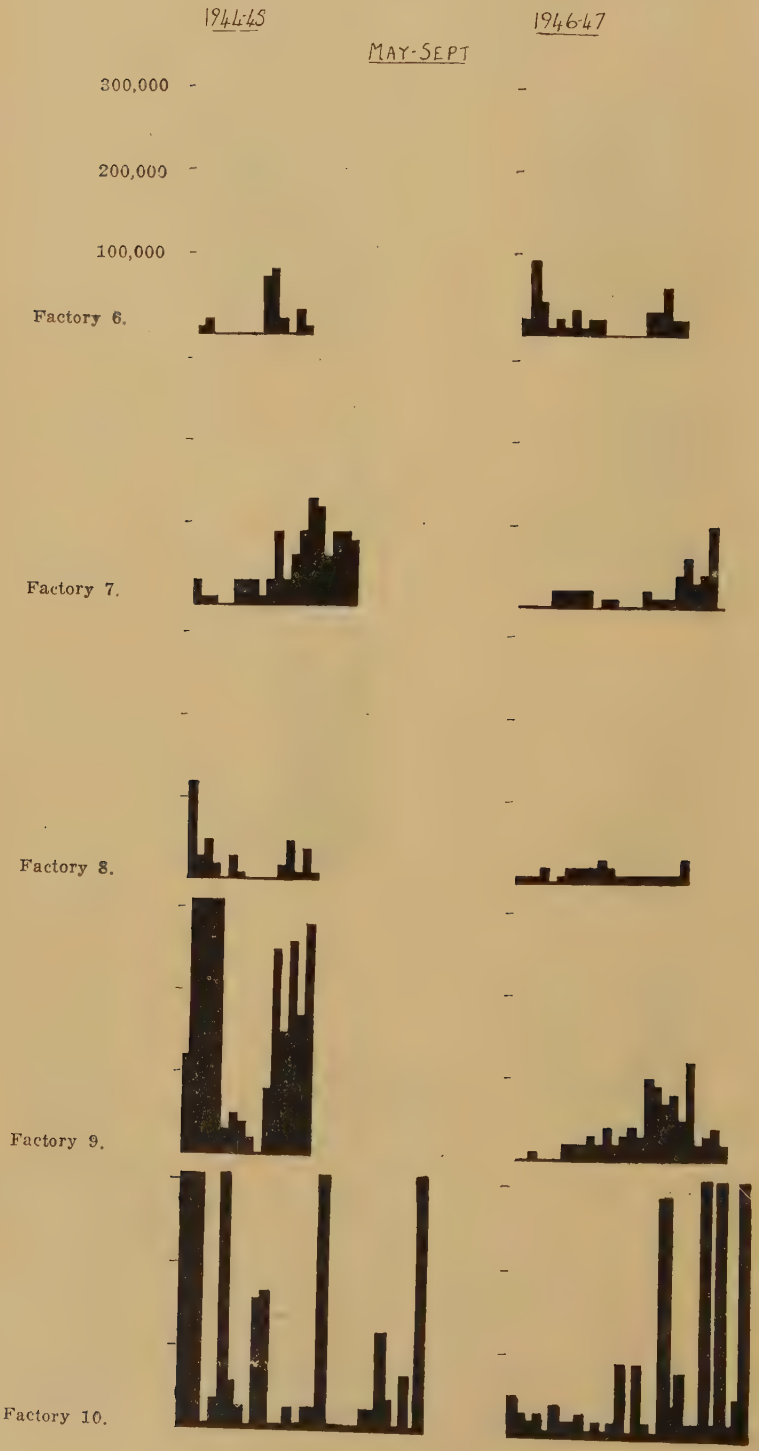
Total Counts.

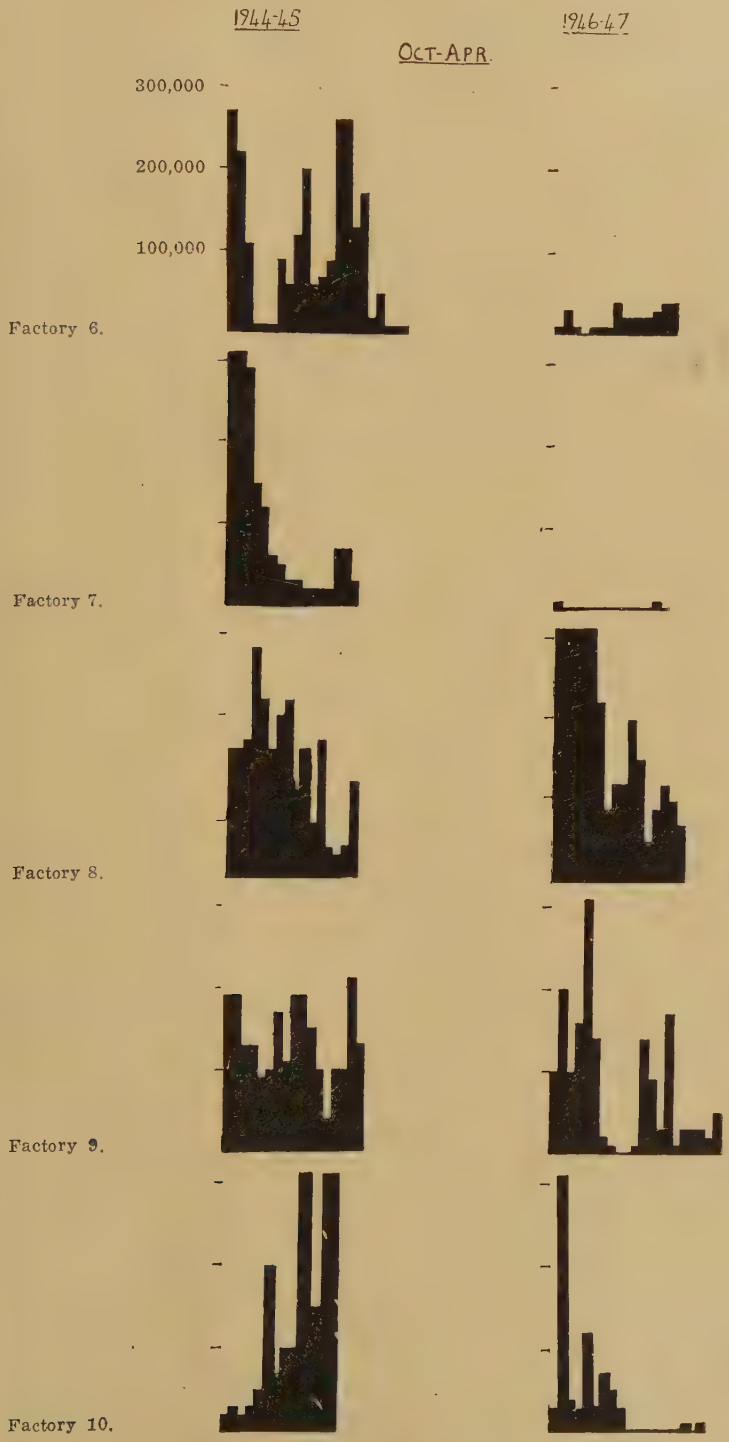
The following diagrams have been prepared to illustrate the general improvement which has taken place in most factories since the service was commenced. These diagrams, when read on the vertical axis, show the Total Count in terms of organisms per cc. and on the horizontal axis, the individual examinations made. The year has been divided into two parts corresponding roughly to the warm (October to April) and cool season (May to September). These groups for each year 1944-45 and 1946-47 are placed beside each other, so that by reading across the diagram it is possible to obtain a picture of the improvement or deterioration in the general bacterial condition of the factory under the same seasonal conditions.

It has not been possible to perform the same number of examinations for each factory and therefore, the tests do not correspond in point of time, but they do fall within the two main seasons into which the year has been divided.


1944-45
MAY-SEPT.
1946-7
300,000
200,000
100,000
Factory 1.
Factory 2.
Factory 3.
Factory 4.
Factory 5


1944-5
Oct-Apr.
1946-7
300,000
200,000
100,000
Factory 1.
Factory 2.
Factory 3.
Factory 4.
Factory 5.


1944-45
1946-47
MAY-SEPT
300,000
200,000
100,000
Factory 6.
Factory 7.
Factory 8.
Factory 9.
Factory 10.


1944-45
1946-47
OCT-APR.
300,000
200,000
100,000
Factory 6.
Factory 7.
Factory 8.
Factory 9.
Factory 10.

Of the ten factories, six have improved considerably, (Nos. 1, 2, 3, 5, 6, 7) two slightly (Nos. 9 and 10) one slightly for the cool season, followed by deterioration in the warm months, (No. 8) while one has deteriorated (No. 4). This improvement, however, is not sufficient and there yet remains scope for considerable reduction in the bacterial count before a sufficiently high standard is reached.

The system of performing surveys of equipment in the factories will speedily improve quality, and permit of the immediate application of remedial measures.

It will be observed that many low counts were recorded in the warmer portion of the year despite the fact that atmospheric temperatures would be more favourable for the multiplication of bacteria. This may be due to the higher summer temperatures favouring the rapid drying of factory equipment after cleansing, and thus rendering moisture conditions not so suitable for bacterial growth. The degree of improvement in the short period under discussion is pleasing, but further work is needed before the position can be considered satisfactory.

Chemical Examinations.

Determinations of moisture, fat, salt, curd and serum p.H. are made to ensure that the consuming public receives an article equal to the prescribed chemical standard, and to assist the factories in their manufacturing technique.

The p.H. value is included because of its relationship to the keeping quality of butter during storage. Changes in butter may be attributed to two main causes:—

(1) The activity of micro-organisms.

(2) Chemical changes.

Micro-organisms require certain degrees of acidity or alkalinity to function at their optimum. Simply speaking, the p.H. value of the butter serum measures not the total acid or alkali, as is done with a titration, but the available acid or alkali at any particular time. It is this availability which determines the optimum conditions both for micro-organic and chemical changes. The p.H. is only one of several factors which will effect these changes. Temperature and the physical condition of the butter also play important parts, but the p.H. has been used successfully as an indication of the keeping quality of butter during storage(2).

Experimental data has shown that the optimum keeping quality range lies between 6.7 and 6.9, but values up to 7.2 are not harmful. When the p.H. rises above 7.2 or falls below 6.7, the keeping quality of the butter may be expected to be poor. Since the attainment of the desired p.H. depends on the efficiency of the neutralisation of the cream before churning, this process must be efficient. p.H. determinations therefore can be used to check the accuracy of the factory technique.

The following table gives the p.H. results obtained for the years 1944-45 and 1946-47, and which have been discussed above in relation to the bacterial content in terms of Total Count. The table has been divided to show the number and percentage of samples falling into ranges—less than p.H. 6.7, p.H. 6.7 to 6.9, p.H. 7.0 to 7.2, and values greater than 7.2 p.H. Values less than 6.7 and greater than 7.2 are undesirable. Although the range p.H. 6.7 to 7.2 is permissible, the narrower range of 6.7 to 6.9 is preferred.

p.H. OF BUTTER SERUM.

Factory.	Total Samples.	Year.	Less than 6·7		6·7—6·9		7·0—7·2		Greater than 7·2	
			No.	%	No.	%	No.	%	No.	%
1	43	1944–45	31	72·1	6	13·9	...	...	6	13·9
	49	1946–47	8	16·3	17	34·7	19	38·8	5	10·2
2	41	1944–45	11	26·8	11	26·8	15	36·6	4	9·8
	44	1946–47	3	6·8	34	77·3	7	15·9	...	...
3	39	1944–45	26	66·7	7	17·9	3	7·7	3	7·7
	42	1946–47	31	73·8	8	19·0	3	7·1	...	...
4	35	1944–45	8	22·9	17	48·5	10	28·6	...	...
	46	1946–47	17	37·0	15	32·6	7	15·2	7	15·2
5	32	1944–45	1	3·1	9	28·1	5	15·6	17	53·1
	25	1946–47	7	28·0	7	28·0	3	12·0	8	32·0
6	46	1944–45	...	...	15	32·6	18	39·1	13	28·3
	35	1946–47	4	11·4	13	37·1	16	45·7	2	5·7
7	56	1944–45	3	5·4	2	3·6	28	50·0	23	41·1
	40	1946–47	...	...	...	...	5	12·5	35	87·5
8	50	1944–45	10	20·0	14	28·0	20	40·0	6	12·0
	25	1946–47	7	28·0	16	64·0	2	8·0	...	...
9	50	1944–45	4	8·0	13	26·0	33	66·0	...	...
	45	1946–47	5	11·1	22	48·9	17	37·8	1	2·2
10	51	1944–45	8	15·7	20	39·2	16	31·4	7	13·7
	34	1946–47	1	2·9	14	41·2	13	38·2	6	17·6
All Factories	443	1944–45	102	23·0	114	25·7	148	33·4	79	17·8
	385	1946–47	83	21·6	146	37·9	92	23·9	64	16·6

The table shows that four of the factories have improved considerably (Nos. 1, 2, 8, 9,), three moderately, (Nos. 3, 6, and 10), one has remained practically the same (No. 5) while two have deteriorated (Nos. 4 and 7). With respect to the optimum range of 6.7 to 6.9 when considering all factories it will be noted that there has been a moderate improvement from 25 per cent. to 37 per cent. within the most desirable range.

REFERENCES.

(1) Cullity and Griffen: "Rabbito and Surface Taint in Butter," *Journal of Department of Agriculture, W.A.*, Vol. 15, June, 1938, p. 137.

(2) Kretchmar: "The Relationship between the Hydrogen Ion Concentration, the Flavour, and the Keeping Quality of Butter," *Journal of Department of Agriculture. W.A.*, Vol. 15, September, 1938, p. 330.

"Yarloop" (White Seeded) Subterranean Clover (Trifolium Subterranean)

H. G. ELLIOTT Agrostologist.

C. A. GARDINER, Government Botanist.

IN Western Australia the name subterranean clover has been known for many years, and over that period many strains of this clover ranging from extra early to late maturing ones have been found. These strains grow successfully under varying soil and rainfall conditions in this State.

One of the most recent strains now commercialised, is that one known as "Yarloop" subterranean clover, which is also called "Albino," or "White Seeded" subterranean clover. This clover as far as can be ascertained, originated in the vicinity of the Yarloop-Cookernup area of this State. During the past year much controversy has occurred as to where it actually originated and just where it was first discovered. Some growers claim that they have different strains of this type, but no serious attempt has been made, as yet, to determine these claims. However it is approximately eight years since it first came into prominence as a commercial clover.

Yarloop subterranean clover growing on the property of J. Woodier, Harvey West, 1941.

"Yarloop" subterranean clover is an early flowering, quick growing, pale green leaved, heavy bulk producing type, which grows under many and varying conditions in the medium and high rainfall areas of the South-West. This clover appears to prefer the water-logged, heavy clayey lands on the coastal plain, but will grow well on other soil types, including the winter wet light sandy ones.

By far the most important development which has occurred in the South-West during the last eight years has been the progress and extension of this clover, as,

large areas of more or less useless winter-wet, heavy clayey land in the areas west of the railway line from Pinjarra to Brunswick have been brought into heavy production by the introduction of this clover in conjunction with superphosphate.

Description of Plant.

A prostrate annual plant of spreading habit, less clothed with silky hairs than the common strains of subterranean clover and paler in colour. Stipules broad, lanceolate, acute. Leaves on long stalks, the leaflets broadly obovate. Flowers two or three together on axillary peduncles, at first erect, lengthening considerably after flowering and turning down to the ground. The upper flowers of the head are barren, forming short whitish barbed processes, each with five spreading pointed teeth, and representing undeveloped calyces. When the peduncles curve downwards the fertile flowers turn back, and the inner barren flowers become outermost and surround the fertile flowers, protecting the maturing pods.

The flowering calyx is green; the tube is without hairs, many nerved in fruit and the lobes are long and narrow. The standard is twice as long as the calyx-lobes.

Yarloop subterranean clover growing on heavy clay country, West Harvey, 1941.

The pod contains only one seed, which, when ripe, is large and white in colour, and the most easily recognised of the subterranean clover strains. The burr contains from one to three seeds.

Seed and Strain—Prior to 1947 all seed purchased by intending growers of "Yarloop" subterranean clover was sold in the burr, and consequently it was difficult to detect impurities of other varieties. The burr was sold at varying prices from 12s. 6d. to £1 per bag, but there was no guarantee as to the actual weight of seed in a bag. The amount of seed in a bag could vary from less than 2 lbs. to 10 lbs. or more with a probable average of 3 to 4 lbs.

Early in 1947 the first cleaned seed was marketed at Harvey. This seed gives a reasonable guarantee as to trueness of strain owing to the creamy white colour of the seed, also the purchaser of cleaned seed now knows what quantity he can sow to obtain a reasonable stand. Up to 1947 and prior to clean seed being available, a farmer sowed from one to four bags of burr per acre to obtain a reasonable stand. It is anticipated that within the next twelve months practically all new sowings will be carried out by using clean seed sown at rates varying from 2 lbs. to 4 lbs. per acre.

At the present time "Yarloop" subterranean clover seed cannot be obtained as certified seed.

Where to Sow.

"Yarloop" subterranean clover appears to be able to adapt itself to a fairly wide range of soils and conditions. It is growing successfully in areas of 19 to 45 inches of winter type rainfall. This clover however, appears to be best suited to the heavy winter water-logged clayey soils but will grow well on a variety of soil types including the lighter sandy types which are winter wet. A good association plant under most conditions, is Wimmera rye grass.

Soil Preparation.

Very little in the way of soil preparation is necessary. Surface scarification of the land is all that is required. If possible the land should be harrowed after sowing operations are completed.

Competition.

On areas where drooping flowered clover (T. cernium) or Boyds clover (Lotus hispidus), flourishes, "Yarloop" subterranean clover will grow well, and providing no soil deficiencies such as copper or zinc occur, and it is adequately topdressed annually with superphosphate, it will compete successfully with the other plants and ultimately dominate the sward.

Inoculation.

It is essential when sowing clean seed on new land that the seed be inoculated with correct strain of nitro-fixing bacteria—these bacterial cultures can be obtained from this Department at a low cost.

Rate of Seeding.

At the present time with clean seed at 4s. 6d. lb. it is not recommended to sow more than 2 to 3 lbs. per acre, but the best rate of seeding to obtain a quick full stand in one year would be 4 to 6 lbs. per acre. When using burr the usual recommendation is to sow two bags per acre, but at the price of 15s. or more per bag it is very costly to establish an area by this means. Clean seed is more economical and free of weed and insect pests.

Fertilizer.

When establishing it is recommended to use at least 2 cwts. superphosphate per acre, this being applied in the autumn at the time of planting the seed. Subsequent annual applications of 1½ to 2 cwts. of super applied in the early autumn is recommended.

Management.

During the first year of establishment do not graze until after the winter is finished, and then only graze lightly to allow heavy seeding down. After drying down grazing can be carried out as the bulk of the burr will be buried. This clover will bury burr in the heaviest of clay and quite often to a depth of ½ to 1 inch. In subsequent years if the land is of the heavy or clayey type, it is not recommended to graze in the winter months owing to the damage done by cattle to the land. Of all the subterranean clover strains this one is probably the best for production of early feed being far superior to other strains such as First Early "Dwalganup," Mid season "Mt. Barker," and the Late "Tallarook."

Palatability.

Experience shows that this clover is as palatable as the "Mid season" type both in the green and dry stages and although no chemical analysis have been carried out as yet evidence points to the fact that it appears equal to the other varieties in value.

Breeding For Non-Broodiness.

A. J. MILLINGTON—Geneticist.

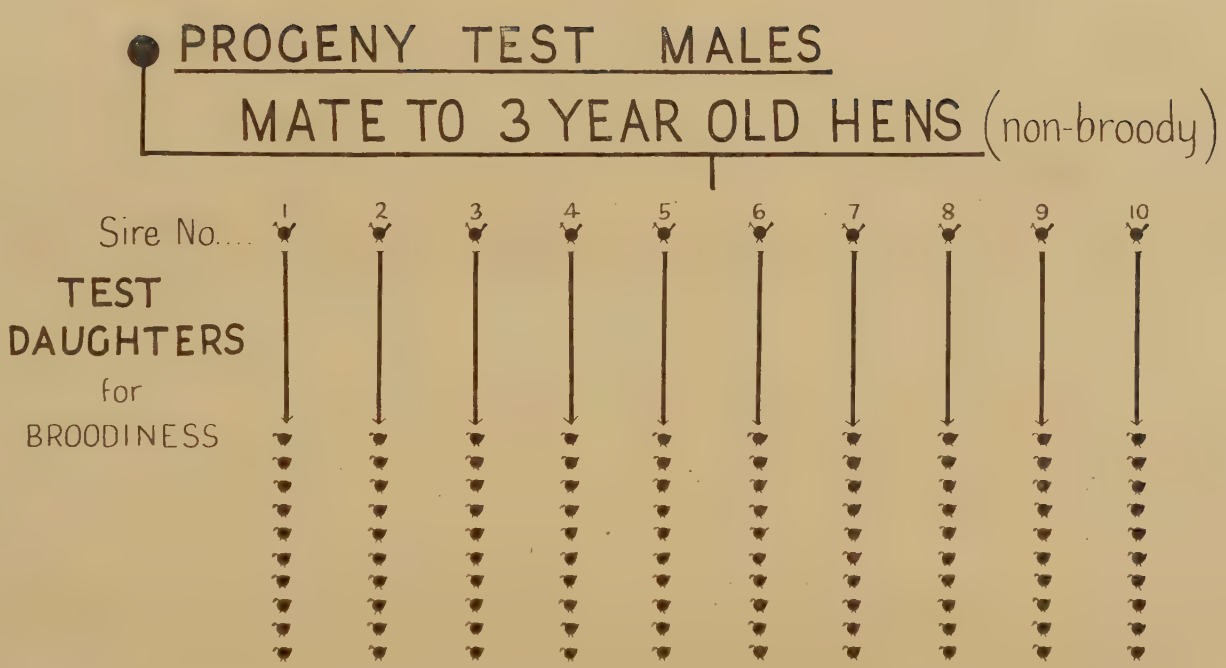
E. LOVEGROVE—Poultry Adviser.

BROODINESS is one of the first characteristics which the poultry-man seeks to eliminate in his constant search for higher egg production. The mode of inheritance of broodiness places it beyond the scope of ordinary mass selection as two non-broody lines or breeds may give progeny which are all broody. However, the inheritance or genetics of broodiness is fairly well understood and by careful selection and progeny testing it can be eliminated from the flock.

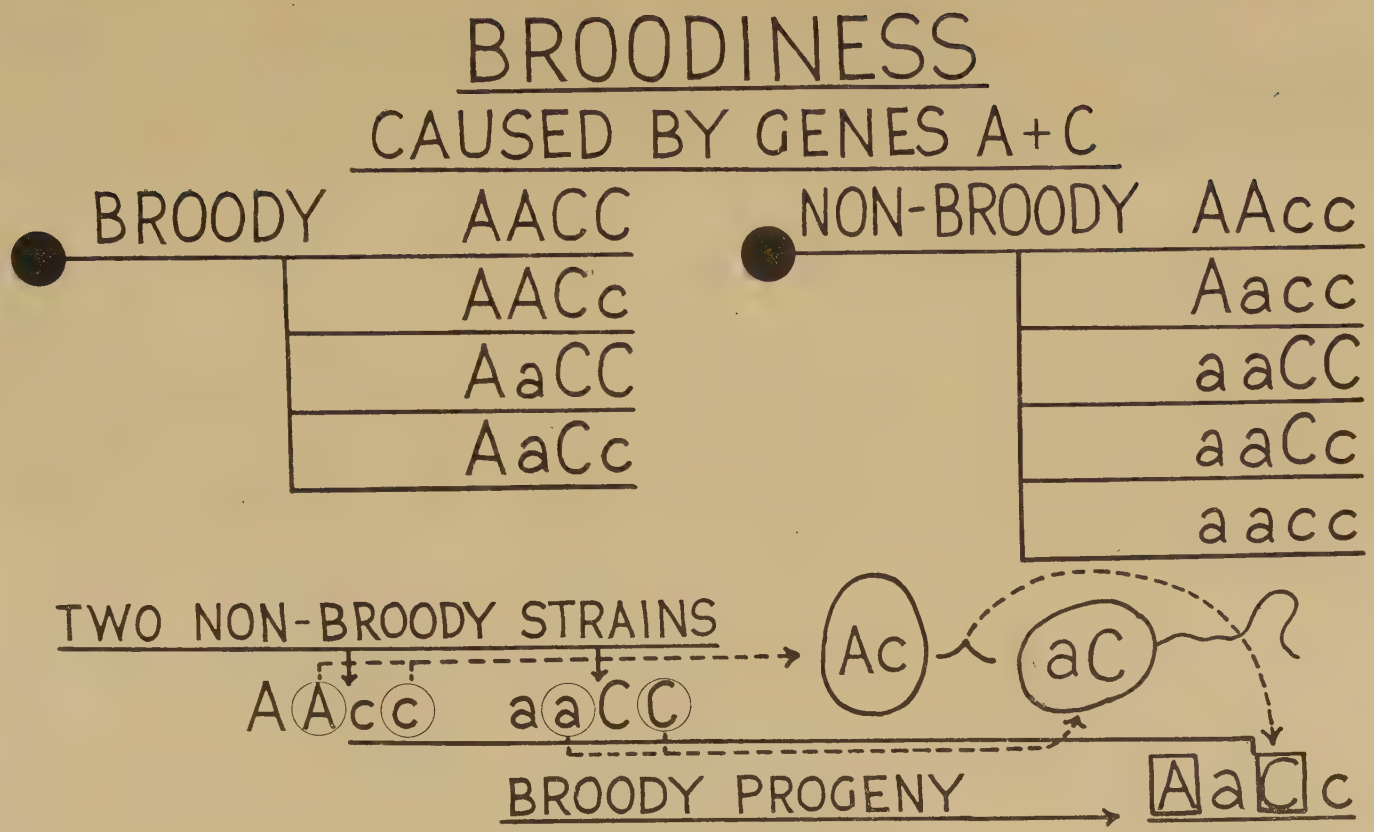
Three-year-old hens with an established record for non-broodiness are used for test mating young sires. About four or five hens will be required for each cockerel and both the male and female progeny of each mating should be retained. If all the female progeny of a particular male is non-broody in their first, second and third years it is fairly safe to assume that matings within the family so established will continue to be free of broodiness. The males can be mated with their half-sisters to establish a non-broody family but matings to other non-broody lines should be exploratory as two families between them may carry the heredity necessary for broodiness. Broodiness may be deferred until the second and third years so that data on the pullet year can be unreliable.

Genetics for Broodiness.

The accepted theory is that broodiness is dependent on the presence of two dominant genes A and C. Broody birds will have the genetic constitution AACC, AaCC, AACc or AaCc. Where only one or neither of the dominant genes is present, the birds will be non-broody and have the genetic constitution AAcc, Aacc, aaCC, aaCc or aacc. When "non-broody" breeds such as the Leghorns or Langshans are crossed they give broody progeny because one contributes the dominant gene A and the other C.



(See article page 231.)



(See article page 231.)

Perching.

E. LOVEGROVE, Chief Poultry Adviser.

S. FROOME, Inspector.

SOME years ago the Department of Agriculture published a short article advocating the use of the ladder type of perching for poultry. Many poultry farmers have introduced this form of perching and they report most satisfactory results. It would appear that the advantages are:—

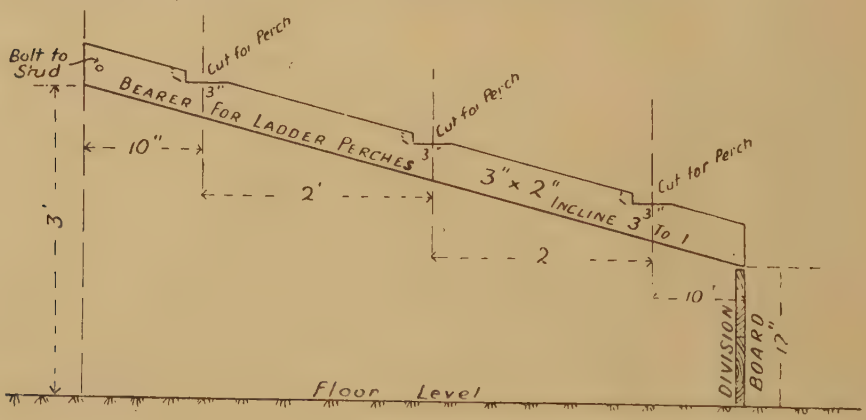
(a) Owing to the fact that the heads of the birds are at least two feet apart and are at three different levels, there is a low incidence of colds.

(b) Fresh air circulates freely between the perching birds and consequently assists to keep the stock healthy.

(c) There is less danger of overcrowding.

(d) Due to the incline of the perches, less floor space is required.

The accompanying sketch illustrates the design of the perches and it will be noted that the back is two feet higher than the front.



The perches are spaced as follows:—

Top perch—10 inches from the back wall and 3 feet above the floor.

Second perch—2 feet from the top perch and approximately 2 feet 2 inches above the floor.

Third perch—2 feet from the second perch and 15 inches above the floor.

The standard laying shed designed to contain 150 birds provides for the perches to be approximately 27 feet long. It is usual to construct three sets of perches, each set being three perches 9 feet long. The bearers supporting the perches are bolted to the studs in the back wall which allows the front of each set of perches to be raised and fastened to the roof to facilitate cleaning.

The commercial poultry farmer is faced with the problem of a fairly high concentration of birds and the consequent increase in the incidence of intestinal worms. Part of the life history of the common round worm of poultry is as follows:—

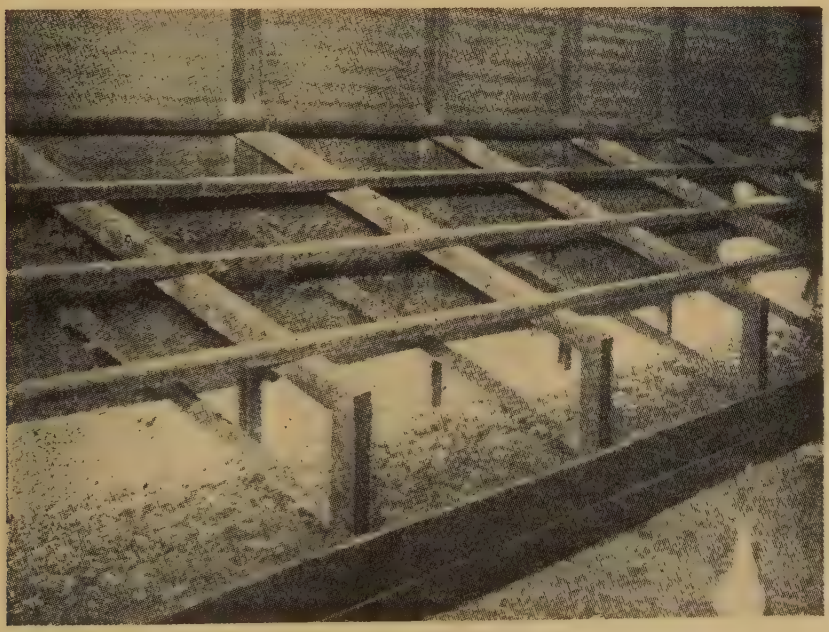
> "After the eggs from the adult worms are passed in the droppings, they become infective for another bird in one or two weeks."

Therefore, it is most important, particularly after a flock has been treated for worms, to prevent the birds being infected by the ingestion of worm eggs voided in the droppings.

With this object in view it is advisable to fasten 2 inch mesh wire netting to the underside of the perches to prevent the birds having access to the droppings on the floor below the perches.

The netting can be fastened to the bearers and will not prevent the perches being raised for cleaning, though in this case a division board would need to be placed along the front.

The illustration below shows the ladder types of perches in use on Mr. Stocker's farm at Roleystone.



Wire netting of perches to prevent fowls gaining access to night droppings.

In this case the wire netting to prevent the fowls gaining access to the night droppings is fastened to battens about 10 inches below the perches; but is a permanent fixture. On this farm the droppings are cleaned away through the opening at the back of the shed and are then collected and disposed of.

Stock Foods.

The following Stock Foods have been registered at the Department of Agriculture under the Feeding Stuffs Act, 1928-46 for year commencing 1st July, 1947.

Stock Food.	Reg. No.	Brand.	By whom Registered.	Materials from which Made.	Registered Analysis.							
					Crude Protein.	Crude Fat.	Crude Fibre.	Sodium Chloride.	Phos. Acid (P_2O_5).	Lime (CaO).	Other.	
					% (Min.)	% (Max.)	%	%	%	%	%	%
A.—SIMPLE FOODS.												
1.—*Meat Meals.*												
Meat Meal	22	J.K.S. No. 1	J. Kitchen & Sons Pty. Ltd.	Animal Fat and Bone	40·00	11·00	2·50	....	14·00	....	....	....
Do.	61	ANCHO	Anchorage Butchers, Ltd.	Waste meat products	50·56	15·89	1·48	0·56	9·39	11·24	....	....
Do.	129	SPEEDY	J. L. Taylor	Animal offal	38·00	14·00	5·00	0·50	15·00	21·00	....	....
Do.	135	STATE ABATTOIRS	State Abattoirs	Waste meat and offal	51·00	14·00	2·00	....	....	....	....	....
Meat and Bone Meal	100	S.M.P.	W. R. and N. N. Clarke	Meat and bone	60·00	7·00	....	....	....	....	....	....
Do.	30		C. A. Kirkby & Sons	Meat and bone	50·00	12·00	4·00	....	....	....	....	....
Protein Meal	63	PENNELIS	W. Angliss & Co. (Aust.), Pty., Ltd.	Animal	50·00	12·00	2·00	....	....	....	....	....
Meat and Bone Meal	116	IMPERIAL (In Diamond) EXCELSIOR	Barrow Linton	Meat and bone	40·00	15·00	1·50	....	....	....	....	....
2.—*Bone Meals.*							(Min.)					
Bone Meal	62	ANCHO	Anchorage Butchers, Ltd.	Waste meat products	23·63	2·44	Trace	Trace	26·76	26·95	....	....
Bone Flour	1	TRICALOS	Davis Gelatine (Aust.) Pty., Ltd.	Sterilised bone flour	5·00	....	....	....	32·50	40·00	....	....
Bone Meal	130	SPEEDY	J. L. Taylor	Animal bones	7·00	2·00	1·00	....	26·00	35·00	....	....
3.—*Other.*										$CaCo_3$		
Lin Meal	126	WESTERN	David Gray & Co.	Linseed meal, yeast meal, bone meal, and minerals	25·00	5·00	7·00	....	....	1·50	....	....
Peanut Meal	3	ETA	Cruickshank Bros.	Peanut kernels	49·00	2·00	6·00	....	....	....	....	....
Milk Sugar Food	6	KRAFCO	Kraft Walker Cheese Co Pty., Ltd.	Whey from cheese manufacture	10·00	0·50	....	....	1·00	CaO 0·70	Lactose 68·00	Riboflavin 25 u/gm.
Do.	7	LACTOKRAFT	do. do. do.	do.	10·00	0·50	....	....	1·00	0·70	68·00	25 u/gm.
Linseed Oil Meal	54	MLM	Meggitt Ltd.	Linseed	30·00	4·00	10·00	....	....	....	....	....
Wheat Meal	78	WESFARMERS	The Westralian Farmers Co-operative, Ltd.	Wheat	8·50	1·00	3·00	....	....	....	....	....
Roller Bran	79	do.	do. do. do.	do.	8·50	....	9·00	....	....	....	....	....
Protein Meal "A"	72	do.	do. do. do.	Meat meal, butter milk, maize meal, and minerals	35·00	8·00	4·00	2·00	....	8·00	Trace	
Protein Meal "B"	73	do.	do. do. do.	Meat meal, liver meal*, bone meal, and mineral	35·00	7·00	4·50	....	....	15·00	....	...

Dried Butter Milk	8	SUNNYWEST	South-West Co-operative Dairy Farmers, Ltd.	By-product of butter	38·00	1·00	....	.. ..	....	....	Lactose 50·00	Mineral Matter 8·40
Eggoleen	117	EGGOLEEN	Barrow Linton & Co.	Meatmeal, livermeal, bonemeal, buttermilk powder, salt and other minerals.	40·00	12·00	1·50	.. ..	....	....	....	....
Pollato	132	THOMAS	W. Thomas & Co. (W.A.), Ltd.	Wheat	8·00	....	9·00	....	....	....	....	....
Branato	133	do.	do. do. do.	do.	8·00	....	9·00	....	....	....	....	....
"C" Meal	134	do.	do. do. do.	do.	8·00	....	9·00	....	....	....	....	....
B.—COMPOUND FOODS												
1. *Cattle Food.*												
Cattle Food	23	EVE-LYN	Tropical Traders Ltd.	Linseed meal, linseed (whole) pollard, salt, limestone, chalk, animal charcoal, molasses sulphur, sulphate of iron, copper sulphate, medicinal herbs.	7·62	5·47	14·04	5·06	7·21	9·52	6·46	
Sweet Cow Food	31	THOMAS	W. Thomas Co. (W.A.) Ltd.	Bran, wheaten meal, flax, chaff and or malt combings, mill screenings, molasses, calcium, sodium chloride.	9·00	1·50	15·00	1·50		Ca 4·00		
Sweet Dairy Food	32	do.	do. do. do.	Bran, pollard, wheaten meal wheat germ, pea meal, malt combings, molasses, calcium, sodium chloride.	11·50	1·50	8·50	1·75		4·00		
Mormilk No. 2	50	PANNIFEX	F. W. Wright & Co.	Flax linseed bols, refuse wheat polishings, rice meal, rope seed meal, bone meal, oat pollard, meat and bone meal,.	20·00	4·75	14·00	Trace	Trace	Trace		
Dairy Meal	55	VETAMAC	A. H. McDonald & Co.	Wheat meal, linseed meal, maize meal, molasses, bone meal, minerals.	10·00	2·50	5·00	Max. 26·00			8·15	
Sweetened Dairy Meal	64	WESFARMERS	Westralian Farmers Co-operative Ltd.	Wheatmeal, bran, oatmeal, linseed meal, minerals, clover pollard, molasses, bonemeal.	11·00	2·50	6·00	1·00		Less than 1·00		·003
Sweet Dairy Food	118	WESTERN	David Gray & Co.	Mill offal, wheatmeal, malt combings, oat meal, yeast meal, linseed meal, molasses lime salt	12·00	3·00	10·00	·50		1·50		
2. *Calf Foods.*											Salts and Medicinal Herbs 3·38	
Calf Food	24	EVE-LYN	Tropical Traders Ltd.	Wheat, pollard, linseed (whole) salt, sugar, chalk, minerals, and herbs.	10·75	4·77	3·86	2·89				
do.	29	PARSONS	Parsons Bros. & Co. Pty. Ltd.	Wheat, oat brouning, salt linseed, ground limestone.	12·00	2·00	6·00	1·00				
Calf Milk	33	THOMAS	W. Thomas & Co. (W.A.) Ltd.	Milk powder, whey powder, maize meal, pollard, calcium, sodium chloride.	13·50	2·50	6·00	1·25		Ca 10·00		

Stock Food.	Reg. No.	Brand.	By whom Registered.	Materials from which Made.	Registered Analysis.							
					Crude Protein.	Crude Fat.	Crude Fibre.	Sodium Chloride.	Phos. Acid (P_2O_5).	Lime (CaO).	Other.	
					% (Min.)	% (Max.)	%	%	%	%	%	%
Calf Food	56	VETAMAC	A. H. McDonald & Co.	Wheat pollard, maize meal, linseed meal, milk sugar, mutton bird oil	15·35	7·50	1·50					
Do.	65	WESFARMERS	The Westralian Farmers Co-operative Ltd.	Wheat meal, maize meal, barley meal, bran, buttermilk, whey powder, linseed meal, cal. carb. bone meal, salt mineral	13·00	3·50	6·00	Less than 1·00	....	Less than 2·00	Trace	
Do.	123	WESTERN	David Gray & Co.	Linseed meal, yeast meal, pollard, wheat germ, maize meal milk powder, lime, minerals	20·00	4·00	9·00	....	....	1·50	Trace	
Do.	131	THOMAS	W. Thomas & Co. (W.A.) Ltd.	Wheat meal, linseed meal, Sod. chlor., Calcium.	15·50	2·50	6·50	3·00	....	Ca 15·00		
3. *Sheep Foods*												
Sheep Food	25	EVE-LYN	Tropical Traders Ltd.	Linseed meal, linseed (whole), pollard, salt, limestone, chalk, animal charcoal, molasses, minerals, herbs.	9·81	5·95	14·79	5·82	4·34	10·15	Other 6·67	
Sheep Maintenance Cubes	66	WESFARMERS	The Westralian Farmers Co-operative Ltd.	Oat, wheat, barley, linseed, peanut and cocoanut meals, clover pollard, bone meal, molasses salt and minerals.	14·00	3·00	7·50	Less than 1·00	....	Less than 2·00	Trace	
Sheep Breeder Cubes	67	do.	do. do. do.	do. do. do.	18·00	3·00	7·50	0·50	....	2·00	Trace	
Ewe & Lamb nuts	122	WESTERN	David Gray Co.	Linseed meal, yeast meal, bone meal, wheat germ, malt, minerals.	25·00	5·00	7·00	....	....	1·50	Trace Copper and Cobalt	
(4.) *Poultry Foods*												
Poultry Mash	4	K.B.	C. A. Kirkby & Sons	Wheat, milk, bone meal, bran, pollard, salt	13·00	3·45	7·00	0·26	1·21	0·10		
Laying Mash, No. 1	5	MILLERS	W. H. Milne & Co.	Bran, pollard, wheat meal, meat meal, bone meal, whey powder, salt	14·00	3·04	5·50	1·50	1·84	2·58		

Quick Lay	34	THOMAS	W. Thomas & Co. (W.A.), Ltd.	Dried yeast, meatmeal, bloodmeal, liver meal, wheaten meal, Calcium, Sod. Chlor.	35·00	10·00	4·00	1·50 (Max.)	....	15·00 (Max.) Ca	....	....
Quick Grow	35	Do.	do. do. do.	Meatmeal, blood meal, calcium, Sod. Chlor.	25·00	19·00	2·60	2·75	....	15·00	....	....
Special Laying Mash	36	Do.	do. do. do.	Bran, pollard, wheaten meal, Liver meal, calcium, sod chlor.	13·50	3·00	7·50	1·50	....	3·75	....	....
Laying Mash No. 1	37	Do.	do. do. do.	Bran, pollard, wheat germ, pea meal, meat meal, dried yeast calcium, sod. chlor.	14·00	2·50	6·00	1·50	....	3·75	....	....
Do. No. 2	38	Do.	do. do. do.	Bran, pollard, wheaten meal, wheat germ, pea meal and/or meat meal*, calcium, sod. chlor.	11·00	2·50	6·50	1·50	....	3·75	....	....
Fattening Mash	40	do.	do. do. do.	Bran, pollard, wheat germ, wheaten meal, maize meal, pea meal, calcium, sodium chloride	10·00	2·00	6·50	1·50	....	3·75	....	....
Laying Mash No. 1	68	WESFARMERS	Westralian Farmers Co-operative, Ltd.	Wheatmeal, bran, oat meal, pollard, meat meal, whey powder, buttermilk, calcium carbonate, salt	14·00	4·00	7·00	0·50	....	CaCo 2·50	....	....
Laying Mash No. 2	69	do.	do. do. do.	Wheat meal, oat meal, pollard, bran, butter milk, whey powder, calcium carbonate, salt	11·00	3·00	7·00	0·50	....	2·50	....	....
Growers' Mash	70	do.	do. do. do.	Wheat meal, pollard, oat meal, bran, butter milk, meat meal, salt, calcium carbonate	13·00	4·00	7·50	0·50	....	2·00	....	....
Poultry Fattening Mash	71	do.	do. do. do.	Barley meal, wheat meal, pollard, oat meal, butter milk, calcium carbonate, salt	10·00	2·50	6·00	0·50	....	2·00	....	....
Laying Pellets No. 1	74	RED COMB	do. do. do.	Wheat meal, bran, oat meal, pollard, meat meal, whey powder, butter milk, calcium carbonate, salt	14·00	4·00	7·00	0·50	....	2·50	....	....
Do. No. 2	75	do.	do. do. do.	Wheat meal, oat meal, bran, pollard, butter milk, whey powder, calcium carbonate, salt	11·00	3·00	7·00	0·50	....	2·50	....	....
Poultry Fattening Pellets	76	do.	do. do. do.	Barley meal, wheat meal, pollard, oat meal, bran, butter milk, calcium carbonate, salt	10·00	2·50	6·00	0·50	....	2·00	....	....
Growers' Pellets	77	do.	do. do. do.	Wheat meal, pollard, oat meal, bran, butter milk, meat meal, salt, calcium carbonate	13·00	4·00	7·50	0·50	....	2·00	....	....
Poultry Pusher	49	PANNIFEX	F. W. Wright & Co.	Barley, oat, and rice brannings, wheat polishings, pollard, rape seed meal, bran, flax linseed, bolo refuse, blood meal, meat and bone meal	32·00	7·00	8·00	Trace	....	Trace	....	....

* Included when available.

Stock Food.	Reg. No.	Brand.	By whom Registered.	Materials from which Made.	Registered Analysis.							
					Crude Protein.	Crude Fat.	Crude Fibre.	Sodium Chloride.	Phos. Acid (P_2O_5).	Lime (CaO).	Other.	
					% (Min.)	% (Max.)	%	% (Max.)	%	% (Max.) Ca	%	%
Egg Milk	39	THOMAS	W. Thomas & Co. (W.A.), Ltd.	Butter milk powder, milk powder, whey powder, wheaten meal, calcium, sodium chloride	15·00	3·00	4·00	3·00	....	15·00	....	....
Laying Mash	101	MORLAY	R. B. Young	Bran, pollard, wheat meal, meat meal, ground limestone minerals	14·00	3·00	6·00	1·50	2·00	3·00	....	....
Laying Mash "B"	102	do.	do. do.	Bran, pollard, wheat meal, meat and bone meal, ground limestone minerals (linseed meal or cocoanut meal when available)	11·00	3·00	6·00	1·00	3·00	5·00	....	....
Laying All Mash	103	do.	do. do.	Bran, pollard, wheat meal, meat and bone meal, ground limestone minerals (linseed meal or cocoanut meal when available)	13·00	3·00	6·00	1·00	2·00	3·00	....	....
Growing Mash	104	do.	do. do.	Bran, pollard, wheat meal, meat meal, butter milk or whey powder, bone meal and minerals (linseed meal or cocoanut meal when available)	13·00	3·00	6·00	1·00	2·00	4·00	....	....
Growing All Mash	105	do.	do. do.	Bran, pollard, wheat meal, meat meal, butter milk or whey powder, bone meal and minerals (linseed meal or cocoanut meal when available)	13·00	3·00	6·00	1·00	2·00	4·00	....	....
D Mash (Fattening)	109	do.	do. do.	Bran, pollard, wheat meal, meat and bone meals, minerals	11·00	4·00	6·00	1·00	3·00	5·00	....	....
Laying Mash No. 2	110	EGGLAYER	Barrow Linton & Co. .	Bran, pollard, oat, pollard, wheat meal, salt, limestone.	10·00	3·50	4·50	1·00	....	3·00	....	....
Laying Mash	111	do.	do. do.	Bran, pollard, oat pollard, wheat meal, meat meal, salt, limestone	14·00	3·50	4·50	1·00	....	3·00	....	....
Growing Mash	112	GROWELL	do. do.	Bran, pollard, oat pollard, wheat meal, meat meal, salt, limestone, wheat germ	14·00	4·50	4·50	1·00	....	3·00	....	....
Fattening Mash	113	DUKKO	do. do.	Bran, pollard, wheat meal, bone meal, oat pollard, salt, ground limestone	10·00	4·00	4·00	1·00	....	3·00	....	....
Do.	119	WESTERN	David Gray & Co.	Mill offal, wheat meal, yeast meal, linseed meal, oat meal, salt, lime	11·00	3·00	5·00	0·50	....	1·50	....	....

Laying Mash "A"	120	do.	do.	do.	Mill offal, wheat meal, yeast meal, meat meal, liver meal, bone meal, lime, salt	12·00	3·00	7·00	0·50	....	1·50	....	....
Laying Mash "B"	121	do.	do.	do.	Mill offal, wheat meal, yeast meal, linseed meal, bone meal, meat scrap, lime, salt	11·00	3·00	7·00	0·50	....	1·50	....	....
Egg Food	124	do.	do.	do.	Meat meal, liver meal, bone meal, yeast meal, linseed meal, lime	40·00	6·00	4·00	....	....	1·50	....	....
Pullet Food	125	do.	do.	do.	Meat meal, butter milk powder, linseed meal, bone meal, yeast meal, lime	30·00	6·00	4·00	....	....	1·50	....	....
5.—*Chick Foods.*													
Chicken Mash	51	PATRIOT	J. & W. Bateman, Ltd.		Pollard, bran, meat meal, oat meal, powdered milk, bone meal, maize meal, chick feed	15·80	4·20	4·30	....	....	....	....	....
Chick Mash "A"	80	WESFARMERS	The Westralian Farmers Co-operative, Ltd.		Wheat meal, pollard, bran, butter milk, meat meal, liver meal, maize meal, vitamised fish oil, calcium carbonate, salt, manganese sulphate	15·00	4·00	7·00	Trace	....	1·00	Vitamised Fish Oil Approx. 1·00 Mineral Trace	
Chick Mash "B"	81	do.	do.	do. do.	Wheat meal, pollard, bran, maize meal, butter milk, meat meal, vitamised fish oil, calcium carbonate, salt	14·00	4·00	7·00	0·50	....	1·50	Vitamised Fish Oil Aprox. 0·50	
Chick Pellets "A"	82	RED COMB	do.	do. do.	Wheat meal, pollard, bran, powdered milk, meat meal, maize meal, vitamised fish oil, calcium carbonate, salt, manganese sulphate	15·00	4·00	7·00	Trace	....	1·00	Vitamised Fish Oil Approx. 1·00 Mineral Trace	
Chick Pellets "B"	83	do.	do.	do. do.	Wheat meal, pollard, bran, maize meal, butter milk, meat meal, vitamised fish oil, calcium carbonate, salt	14·00	4·00	7·00	0·50	....	1·50	Vitamised Fish Oil Approx. 0·50	
Chicken Milk No. 1	45	THOMAS	W. Thomas & Co. (W.A.), Ltd.		Whey powder, meat meal, blood meal, bone meal, pollard, sodium chloride, calcium	16·50	1·50	4·00	(Max.) 3·00	....	(Max.) Ca 15·00	....	....

Stock Food.	Reg. No.	Brand.	By whom Registered.	Materials from which Made.	Registered Analysis.							
					Crude Protein.	Crude Fat.	Crude Fibre.	Sodium Chloride.	Phos. Acid (P_2O_5).	Lime (CaO).	Other.	
					% (Min.)	% (Max.)	%	%	%	%	%	%
Chicken Milk No. 2	46	THOMAS	W. Thomas & Co. (W.A.) Ltd.	Whey powder, milk powder, bone meal, pollard, calcium, sodium chloride	11·00	1·50	4·00	3·00	....	15·00	....	....
Chick Starter	41	do.	do. do. do.	Bran, pollard, wheaten meal, wheat germ, meat meal, milk powder, maize meal, pea meal, lucerne, pollard, dehydrated vegetables, cod liver oil, calcium, sodium chloride	14·50	2·50	6·00	(Max.) 1·25	....	Ca. (Max.) 3·75	....	....
Chick Starter No. 2	42	do.	do. do. do.	Bran, pollard, wheaten meal, wheat germ, milk powder, whey powder, lucerne pollard, maize meal, calcium, sodium chloride	11·00	1·50	6·00	1·25	....	3·75	....	....
Chick Grower	43	do.	do. do. do.	Bran, pollard, wheat germ, meat meal, pea meal, milk powder, whey powder, maize meal, lucerne pollard, bone meal, calcium, sodium chloride	13·50	2·50	6·00	1·25	....	3·75	....	....
Chick Grower No. 2	44	do.	do. do. do.	Bran, pollard, wheat germ, lucerne pollard, maize meal, whey powder, calcium, sodium chloride	11·00	1·50	6·00	1·25	....	3·75	....	....
Chick Grain	47	do.	do. do. do.	Kibbled wheat, kibbled maize, kibbled peas, shell grit	9·00	1·50	4·50	....	....	....	....	....
Chick Starter	48	MILLERS	W. H. Milne & Co.	Bran, pollard, whey powder, oyster flour, bone meal, oat meal, cod liver oil, salt	15·06	4·34	6·10	1·09	1·84	3·11	....	....
Chick Food	52	PATRIOT	J. & W. Bateman, Ltd.	Cracked wheat, pannicum seed, broken peas, broken maize, shell grit	11·80	3·00	3·80	....	....	....	....	....
Do.	53	HAYNES & CLEMENTS	Haynes & Clements	Wheat, maize, peas, kalo corn, shell grit	9·00	1·50	4·50	....	CaO	3·00	....	....
Do.	60	ANCHOR	G. Wood, Son & Co., Ltd.	Wheat, bran, millet, blue peas, yellow peas, oyster grit, barley pollard, pea pollard, maize, milk	18·00	3·00	6·00	....	....	3·00	....	....
Chick Mash	106	MORLAY	R. B. Young	Bran, wheat meal, maize meal, meat meal, buttermilk or whey powder, bone meal, shellgrit, minerals.	15·00	3·00	6·00	1·00	2·00	5·00		

Chick Allmash	107	do.	do.	do. do. do. do.	14·00	3·00	6·00	1·00	2·00	5·00	
Chick Starter	108	do.	do.	Same as above plus cod liver oil	15·00	3·00	6·00	1·00	2·00	5·00	
Chick Grain	114	"CHIC CHIC"	Barrow, Linton & Co.	Wheat, oats, maize, peas	9·00	27·00	5·00	....	....	....	
Chick Starter	115	"VITALIZER"	do. do. do.	Bran, pollard, wheat meal, oat pollard, wheat grain, meat meal, milk powder, salt, ground, limestone, oil	15·00	4·00	4·5	1·00	....	3·00	
Chick Builder	127	WESTERN	David Gray & Co.	Mill offal, wheat meal, maize, wheat germ, yeast meal, meat meal, bone meal, milk powder, cod liver oil, lime plus vitamin A.	14·5	2·5	4·5	....	....	1·5	Trace
Chick Starter	128	do.	do. do.	do. do.	16·00	3·00	4·5	....	....	1·5	Trace
(6.) *Pig Foods*—											Salts, Minerals and Medicinal Herbs.
Pig Food	26	EVE-LYN	Tropical Traders, Ltd.	Pollard, linseed meal, linseed (whole), salt limestone, chalk, animal charcoal, minerals and medicinal herbs	10·25	10·51	12·35	2·12	4·44	9·60	6·49
										Ca	
Pig Starter	136	THOMAS	W. Thomas & Co. (W.A.), Ltd.	Pollard, lucerne pollard, pea meal, meat meal, calcium, salt.	13·00	1·50	6·00	1·25	....	3·75	
Pig Grower	137	do.	do. do. do.	Pollard, lucerne pollard, pea meal, calcium, salt	12·00	1·50	6·00	1·25	....	3·75	
(7.) *Horse Food*—										CaO.	Salts, Minerals and Medicinal Herbs.
Horse Food	27	EVE-LYN	Tropical Traders, Ltd....	Pollard, linseed meal, linseed (whole), wheat, salt, chalk, minerals and medicinal herb	12·87	5·64	7·14	5·09	1·01	1·54	7·17
(8.) *Dog Foods*—											
Dog Food	9	SNAPPETTS....	A. E. Robinson	Wheat, bone, meat, vegetables.	15·25	13·00	4·00	....	4·00	5·00	
No. 1. Dog Biscuits	10	SNAPS	do. do.	do. do. do	15·00	4·00	3·00	....	3·50	4·00	
Puppy Biscuits	11	do.	do. do.	do. do. do.	15·00	4·00	2·00	....	3·50	4·00	
Hound Meal	12	do.	do. do.	do. do. do.	15·00	4·00	3·00	....	2·50	2·50	
Plain Shapes	13	do.	do. do.	do. do. do.	15·00	4·00	2·00	....	3·50	3·50	
Puppy Meal	14	do.	do. do.	do. do. do.	15·00	4·00	2·00	....	3·50	4·00	
Charcoal Shapes	15	do.	do. do.	do. do. do.	14·00	3·00	6·00	....	2·50	2·50	
Bone Shapes	16	do.	do. do.	do. do. do.	15·00	4·00	2·00	....	3·50	4·00	
Dog Biscuits	17	BOANS LOCAL	do. do.	do. do. do.	15·00	4·00	3·00	....	2·50	2·50	
Bone Shapes	18	SYMONDS	do. do.	do. do. do.	15·00	4·00	2·00	....	3·50	4·00	
C.—STOCK LICKS.											Cu.
Copper Lick	19	C.S.M.L.	Cuming Smith & Mt. Lyall F.F., Ltd.	Dicalcic phosphate, copper sulphate, salt	....	....	....	66·00	12·50	....	0·10 F.E. 20·00 Cu.
Denmark Lick Substitute	20	do.	do. do. do.	Limonite, sulphate of copper, salt	....	....	....	38·00	....	....	0·14

Stock Food.	Reg. No.	Brand.	By whom Registered.	Materials from which Made.	Registered Analysis.							
					Crude Protein.	Crude Fat.	Crude Fibre.	Sodium Chloride.	Phos. Acid (P_2O_5).	Lime (CaO).	Other.	
					% (Min.)	% (Max.)	%	%	%	%	%	%
Dicalcic Phosphate	21	C.S.M.L.	Cuming Smith and Mt. Lyell F.F. Ltd.	Calcium phosphate at least 90% of the P_2O_5 being as dicalcic phosphate	....	....	....	....	37·00	28·00		
Mineral Stock Food	28	SYKE'S	Sykes (Aust.) Branch, Ltd.	Sterilised bone flour and minerals	....	....	....	70·00	5·60	4·4	Minerals.	
Medicated Lick	57	VETAMAC	A. H. MacDonald & Co.	Bone meal, molasses, whole meal, aloes, minerals	....	....	....	53·00	5·70	7·5	11·05	4·75
Mineral Concentrate	58	VETSOLICK....	do. do. do.	Pollard, bone meal & minerals	....	....	....	....	11·00	14·00	18·85	
Coast Compound	59	VETAMAC	do. do. do.	Pollard, aniseed, molasses, minerals	....	....	....	....	....	....	33·88	
Stock Lick	84	WESFARMERS	Westralian Farmers Co-operative, Ltd.	Bone meal and minerals	....	....	....	80·00	0·85	$CaCo_3$. 15·00	0·322	
Dicalcic Lick	85	do.	do. do. do.	Salt, dicalcic phosphate	....	....	....	60·00	15·00	CaO 11·00		
Denmark Lick Substitute	86	do.	do. do. do.	Limonite, salt, copper sulphate	....	....	....	65·00	....	....	F.E. 10·00	Cu 0·15
Lime Lick	87	do.	do. do. do.	Salt, cal. carbonate	....	....	....	35·00	....	$CaCc^3$ 40·00 CaO.	Max. Meals.	Minerals.
Cobaltised and Copperised Concentrated Sheep Lick "D"	88	VITA LICK	Goldsbrough, Mort & Co. Ltd.	Bone flour (degelatinised), bone charcoal, meals derived from the by-products of rice, cocoa and wheat and minerals	....	....	....	....	23·50	30·00	21·50	5·10
Cobaltised and Copperised Sheep Lick Mixed "D"	89	do.	do. do. do.	Bone flour (degelatinised), bone charcoal. meals derived from by-products of rice, cocoa and wheat, molasses, minerals	....	....	....	80·00	3·70	4·70	3·39	0·78
Cobaltised and Copperised Concentrated Sheep Lick "G"	90	do.	do. do. do.	Bone flour (degelatinised), bone charcoal, meals derived from by-products of rice, cocoa, wheat, minerals	....	....	....	....	23·50	31·00	12·70	7·51
Cobaltised and Copperised Sheep Lick Mixed "G"	91	do.	do. do. do.	Bone flour (degelatinised), bone charcoal, meals derived from by-products of rice, cocoa, and wheat, molasses, minerals	....	....	....	80·00	3·80	4·90	2·00	1·20
Cobaltised and Copperised Cattle Lick Concentrated "D"	92	do.	do. do. do.	Bone flour (degelatinised), bone charcoal, rice, cocoa and wheat	....	....	....	....	21·70	29·00	15·30	7·20

Cobaltised and Copperised Cattle Lick Concentrated "G"	93	do.	do.	do.	do.	Bone flour (degelatinised), bone charcoal, rice, cocoa and wheat meals, minerals	....	....	....	....	25·00	32·50	10·20	5·85
Cobaltised and Copperised Cattle Lick Mixed "D"	94	do.	do.	do.	do.	Bone flour (degelatinised), bone charcoal, rice, cocoa and wheat meals, molasses, minerals	....	....	....	75·00	4·20	5·40	3·10	1·6168
Cobaltised and Copperised Cattle Lick Mixed "G"	95	do.	do.	do.	do.	Bone flour (degelatinised), bone charcoal, molasses, rice, cocoa and wheat meals, minerals	....	....	....	75·00	4·40	5·80	1·93	1·3968
Mineral Mixture	96	V.M.M.	do.	do.	do.	Bone flour (degelatinised), bone charcoal, meals derived from rice and cocoanut, minerals	....	....	....	4·30	9·50	12·50	60·20	4·47
	97	VITA LICK	do.	do.	do.	Minerals	....	....	....	Max. 76·00	....	Min. 9·50	....	0·72
Mineralised Blocks Chick-a-Vite	98	CHICK-A-VITE	do.	do.	do.	Bone flour (degelatinised), bone charcoal, cod liver oil, meals from by-products of rice, gentian minerals	....	....	....	....	20·70	27·60	16·50	10·30
Por-co-Vite	99	POR-CO-VITE	do.	do.	do.	Bone flour (degelatinised), bone charcoal, cod liver oil, minerals	....	....	....	13·00	19·10	30·00	....	12·90

Fertilisers.

The following Fertilisers additional to those published in the December, 1946, Journal, have been registered at the Department of Agriculture, under the Fertiliser Act, 1928, for the year commencing 1st November, 1946.—

Name of Fertiliser.	Reg. No.	Brand.	By whom Registered.	Nitrogen (N) as				Phosphoric Acid (P_2O_5) as				Potash K_2O.	
				Nitrate.	Ammonia.	Blood & Bone	Bone-dust	Water sol.	Citrate sol.	Acid sol.	Total.	Sulphate.	Muriate.
				%	%	%	%	%	%	%	%	%	%
3. POTASSIC.													
Sulphate of Potash	65	Chandler	State (W.A.) Alunite Industry	....	....	....	....	....	....	....	....	30·00	....
5.—NITROGEN, PHOSPHORIC ACID AND POTASH													
Orchard Manure, No. 2.	69	Cresco	Cresco Fertilisers (W.A.) Ltd.	5·00	....	....	....	7·00	1·25	·75	9·00	5·00	....
6.—SUPERPHOSPHATE AND COPPER												Copper	Sulph.
Super and Copper, No. 1	66	Sickle	Cuming Smith & Mt. Lyell F.F., Ldt. &	....	....	....	....	14·00	2·50	1·50	18·00	1·25	
B.—ORGANIC.													
Fish Fertiliser	68	Cormo	Norwest Fertilisers	....	5·00	....	....	....	....	....	8·00	....	....
Garden Fertiliser	67	Superhumus No. 2	W. Austin	....	4·00	....	....	3·00	·50	6·50	10·00	·50	....

The registration of the undermentioned Fertiliser published in the December, 1946 Journal has been amended and now reads.

5.—NITROGEN PHOSPHORIC ACID AND POTASH.													
Tobacco Fertiliser No. 5	26	C.S.M.L.	Cuming Smith & Mt. Lyell F.F., Ltd.	3·	3	....	....	9·00	1·50	1·00	11·50	5·70	....

Book Review

Bulletin 38: Imperial Bureau of Pastures and Field Crops.

ADVANCES IN GRASSLAND HUSBANDRY AND FODDER PRODUCTION SECOND SYMPOSIUM.

This bulletin is a second symposium on "Advances in Grassland Husbandry and Fodder Production." Bulletin 32 was the first. The two bulletins are akin to the earlier "Herbage Reviews" series.

The bulletin opens with four articles and the remainder of the "symposium" is a series of summaries, in some instances lengthy, of eleven papers and reports of diverse origin and objective.

The first article on objectives in veld investigations in Southern Rhodesia by West and Rattray gives an excellent appreciation of the problems of veld management and the techniques to be used in the investigations. The similarity of environment to coastal and sub-coastal Queensland gives added interest to the Australian reader. A short article on the economics of ley farming by A. W. Ashby follows. This is mainly of local interest. Professor Travin's discussion on "Formation of Plant Species" is an aspect of geo-botany which is not commonly included in an agricultural botany publication. Travin deduces a correlation between the process of species formation and seismic and volcanic activity and associates new species formation with regions of young geo-synclines. The statistical data presented are not particularly convincing. The fourth article is on "Forage Production in Switzerland"—a translation by Miss Roseveare from the German by Alfred Kauter. This article traces the intensification of cropping and sown pastures for a period of 10 years including the war period, largely because of the urgency of increasing home food production. The methods adopted included intensive extension work and some measure of compulsory ploughing and cropping.

The summaries of papers follow and include two of Australian origin, Schofield's study of coastal pastures at South Johnstone, Queensland, and Andrews report on "Pasture Investigations in Victoria during 1944-45." The other nine summaries are:

A Scottish Method of Grassland Improvement.
Agricultural Seed Production as a New Industry in Welsh Farming.
Grassland Research and Advisory Work in Sweden.
Birdsfoot Trefoil as a Forage Legume.
Hay Dehydration in the South-Western United States.
U.S. Regional Pasture Research Laboratory.
Weeds in Figi.
Pastures and Fodder Plants in Sierra Leone.
Land Resources of Tripolitania.

The subjects of this bulletin are both interesting and valuable but it is scarcely a symposium: rather is it a review.

(Reviewed by J. Griffiths Davies,
Principal Agrostologist,
C.S.I.R Division of Plant Industry).

Note.—Copies of the publication can be obtained at a cost of three shillings (Sterling) from the Imperial Agricultural Bureaux, Central Sales Branch, Agricultural Research Building, Penglais, Aberystwyth, Wales.

ERRATA.

VOL. XXIV., No. 2, JUNE, 1947.

Page 79: *For* "Vol. 24 (Second Series) June, 1947, No. 1" *read* "Vol. 24 (Second Series) June, 1947, No. 2."

Page 84: Second paragraph, "Windbreaks" line two, second last word *for* "Contracting" *substitute* "counteracting."

Page 108: Fig. 15B *for* "Clover crop" *substitute* "Covercrop."

Page 109: Fig. 15C *for* "Clover crop" *substitute* "Covercrop."

Page 115: Line 4, first word *for* "friut" *read* "fruit."

By Authority: W. H. WYATT, Government Printer, Perth.